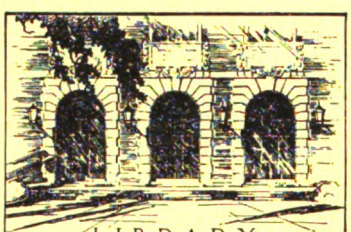
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THE AURORA BOREALIS.

Painted, from actual observations, by Arthur Twidle.

A phenomenon most commonly seen in high latitudes, near the earth's magnetic poles, and due to the discharge of high voltage electricity through the upper rarefied portions of the atmosphere. The discharge varies considerably in form and colour, sometimes

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Continued from Vol. IV., page 467.

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ELECTRICITY AND MAGNETISM.—XX

Self-Induction.—In induction coils and transformers, an electric current in one wire induces another current in a wire quite distinct and insulated from the first, but a current may produce inductive effects in its own coil of wire. As the electric current passes along any one turn, inductive effects are produced in the adjacent turns of wire in the same coil. The electrical result thus produced is called the extra current, and the phenomenon is known as *Self-induction.*

The production of an extra current shows that although electricity "flows" along conductors at an inconceivable speed, an exceedingly minute period of time elapses between the entry of a current at one end of a wire and its exit at the other end. Consequently the magnetic field around a wire carrying a current does not reach its maximum intensity immediately the current commences to flow.

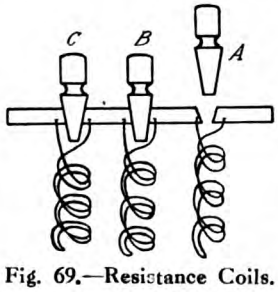
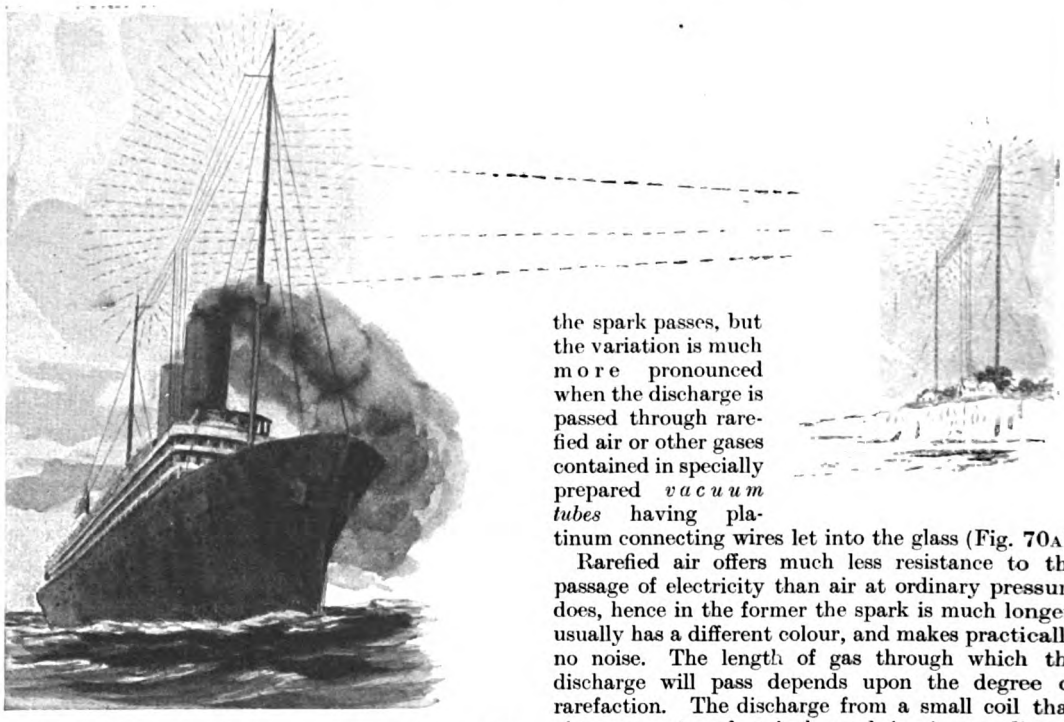


Fig. 69.—Resistance Coils.

Non-inductive windings of Resistance Coils.—In certain forms of apparatus it is necessary to arrange wires so that self-induction is eliminated. In resistance coils, for instance, the wire is doubled back on itself so that the current flows in one direction along one half of the coil, and in the opposite direction along the other half (*see* Fig. 69). Thus any self-inductive effects that would otherwise be produced in the first half of the coil are neutralised by those that would otherwise occur in the second half. Resistance boxes consist of several such coils, having different resistances. The ends of the coils are connected with broad strips of brass, and plugs of the same metal are inserted in the gaps between adjacent strips. If a certain plug *A* is now removed the current is bound to flow through the corresponding resistance coil. By removal of the necessary plugs it is possible to throw into the circuit a resistance of any definite number of ohms that may be required.

It may be permissible to mention here one way in which resistance boxes are used to determine the value of an unknown resistance. Suppose that the resistance of a coil of iron wire is to be found. A circuit consisting of a cell giving a constant current, a tangent galvanometer, the coil whose resistance is to be determined, and thick connecting wire is fitted up, and the deflection of the galvanometer is noted. The coil of wire is then removed, a resistance box put in its place, and plugs removed until the galvanometer needle again gives the same deflection. Certain coils of known resistances are thus substituted for the unknown resistance so that the current in the two cases is the same, hence the resistance of the coil of iron wire can be found. Such a mode of determining the value of a resistance is called the *Method of Substitution.*

Uses of Induction Coils.—The high voltage electricity obtained from the secondary of an induction coil is sometimes termed high tension electricity, since the voltage is great enough to cause the current to "spark" across a gap owing



to the break-down of the air resistance between the secondary terminals.

The character of the discharge largely depends upon the distance across which the electricity passes. If wires from the secondary terminals are placed relatively near to each other, the discharge passes as a rapid series of bluish-white sparks accompanied by a sharp crackling sound. When the distance is increased the discharge becomes less rapid, violet in colour, more branched, and much quieter. When the distance is further increased a form of discharge called a "brush" discharge occurs.

Experiment 61.—*To observe the nature of the discharge from the secondary of an induction coil.*

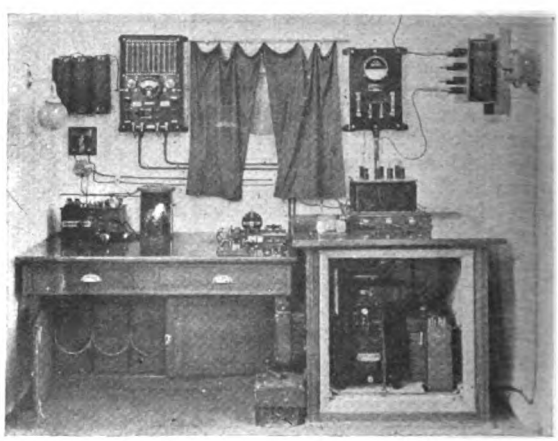
Attach straight narrow wires to the secondary terminals of a small sparking coil, and vary the length of the spark gap between these wires. Note the colour, frequency, form, and accompanying noise of the discharge. Be very careful to stop the current each time before you touch the secondary terminals, or a powerful shock may be received.

Particular care must be exercised when large coils are being used, otherwise very injurious results may be experienced. No part of the person should come within sparking distance of the secondary terminals and wires while the coil is being worked. Introduce one end of a piece of paper into the spark gap and note the perforations caused by the passage of the discharge.

Discharge through rarefied gases.—We have just seen that in air at ordinary pressure the nature of the discharge varies to some extent according to the distance through which the spark passes, but the variation is much more pronounced when the discharge is passed through rarefied air or other gases contained in specially prepared *vacuum tubes* having platinum connecting wires let into the glass (Fig. 70A).

Rarefied air offers much less resistance to the passage of electricity than air at ordinary pressure does, hence in the former the spark is much longer, usually has a different colour, and makes practically no noise. The length of gas through which the discharge will pass depends upon the degree of rarefaction. The discharge from a small coil that gives a quarter of an inch spark in air at ordinary pressure will pass through one or two feet of highly rarefied air.

Electrical discharges through rarefied gas occur on a grand scale in Nature. The beautiful luminous glow seen in the heavens in high latitudes, north or south, and known as the Aurora, is considered to be due to the discharge of high voltage electricity through the upper rarefied portions of the atmosphere. The distribution of the earth's magnetism has some influence on the production of the Aurora, a fact which may explain why the phenomenon is most commonly seen in high latitudes near the positions of the earth's magnetic poles. The



Typical of the cabins from which ships such as that shown above communicate by "wireless" with the land, and other ships at sea.

discharge varies considerably in colour and form. Frequently the colour is of a reddish tint and the form sometimes resembles that of gracefully folded curtains, at other times it appears as broad bands or streamers, or as a broad arc extending across the sky (*cf.* the colour plate facing p. 1, and the illustrations on p. 465, Vol. II.).

The use of different gases in vacuum tubes produces discharges of different colours, for instance, air and hydrogen give shades of red, while carbonic acid gas produces a pale greenish effect. Ordinary vacuum tubes of various shapes, and containing different rarefied gases are made merely for spectacular purposes, but specially adapted tubes containing air at a particular degree of rarefaction are employed for the production of X-rays (Fig. 70B).

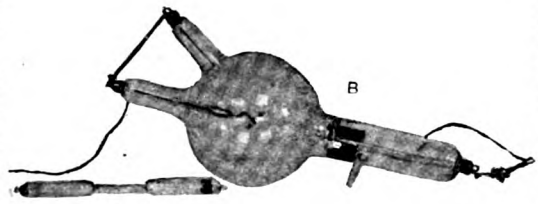
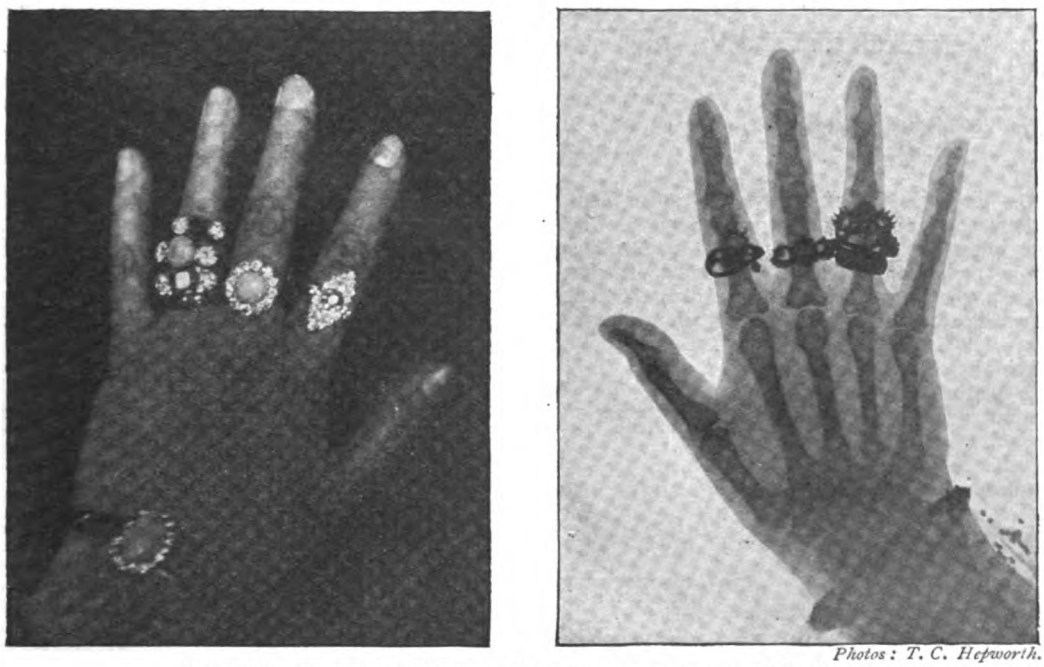


Fig. 70.—*A* **Vacuum Tube; *B*, X-Ray tube.**

X-Rays.—A luminous object, such as an incandescent gas mantle, is visible because certain vibrations emanating from it affect the nerves of the eye, producing what is termed sight. It is supposed that these vibrations are transmitted by a universal medium called æther. Light from distant stars and planets reaches us through æther existing in the space beyond the earth's atmosphere where no ordinary matter is supposed to exist. An incandescent gas mantle radiates not only light vibrations but others capable of showing their existence in different ways, some by their heating effects for instance and others by their chemical effects upon sensitive photographic paper.

When an electric discharge from an induction coil is passed through an X-ray vacuum tube, certain vibrations having different properties from those of light are produced. From the point of view of utility the most important difference lies in the fact that some materials, such as wood, leather, parts of the human body, etc., which are opaque to light are more or less transparent to these vibrations, commonly known as "X-rays," proceeding from the vacuum tube. Bone is semi-opaque and metals are opaque to X-rays, so that if a hand in which a needle is embedded is placed in front of the X-ray tube, the rays fail to pass through the needle, get through the bone to some extent, and pass more easily through the fleshy part of the hand. Now if the hand is situated between the X-ray tube and some substance which is sensitive to X-rays, this substance may indicate in some way the relative opacity to the rays of the different parts of the hand and the needle embedded in it.

Photographic plates are sensitive to X-rays, so that a plate, protected from ordinary light by some



Photos: T. C. Hepworth.

A Lady's Jewelled Hand: Photographed and X-Rayed.

The passage of X-rays through various bodies can be made to yield visible results without the use of photographic plates. Barium platino-cyanide, for example, dusted evenly over the gummed surface of a piece of cardboard forms a sensitive screen: *cf.* the radiograph on p. 11.

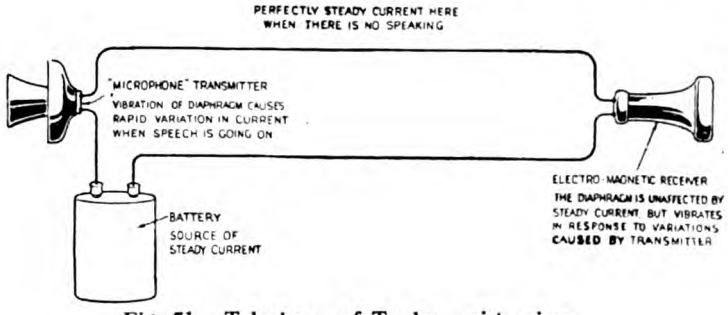


Fig. 71.—Telephony of To-day—with wires.

suitable means such as a black paper envelope, placed in position to receive the X-rays after they have passed through the hand, receives a shadow picture or radiograph. Those parts of the object most transparent to the rays will photograph darkest on the negative but come out lightest on the print.

No rule concerning the length of time during which the plate is exposed to the rays can be given, as the exposure varies according to the size and efficiency of the apparatus used, but the time is much longer than that of ordinary light exposures.

The passage of X-rays through various bodies can be made to yield visible results without the use of photographic plates. Some substances "fluoresce," i.e. become luminous, when X-rays fall upon them, a yellow solid called Barium platino-cyanide being an important example. If this material, specially prepared and finely powdered, is dusted evenly over the gummed surface of a thick piece of cardboard, a sensitive screen or "fluoroscope" is made. This can be used in place of the photographic plate, the platino-cyanide exhibiting various degrees of fluorescence according to the transparency to the X-rays of the objects between the fluorescent screen and the X-ray tube.

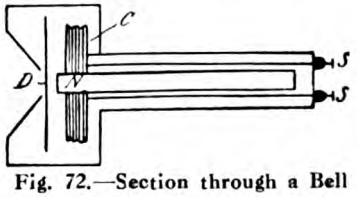


Fig. 72.—Section through a Bell telephone.

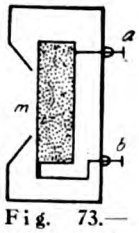


Fig. 73.—Microphonic transmitter: *a* and *b* are terminals.

Wireless Telegraphy.—Space forbids a consideration of anything but a very brief summary of the method of signalling through space without wires.

If wire hoops or other suitably arranged conductors are insulated from the earth but connected to the secondary terminals of an induction coil fitted with a proper spark gap, every time an electric spark crosses the gap, vibrations or waves in the æther proceed rapidly outwards in all directions from the wire hoops. Should these æthereal waves impinge upon a distant but similar arrangement of insulated metallic hoops or wires, electricity is generated in these conductors. The place where the first apparatus is situated is known as the transmitting station, the second as the receiving station. The system of hoops or wires is called the aerial, and the presence of currents induced in the aerial is indicated by an attached delicate piece of apparatus called a detector.

The Telephone.—Another instrument, the working of which is based upon the phenomena of electric-magnetic induction, is the telephone. Figure 72 illustrates the type of transmitter or receiver known as the Bell telephone. A coil of wire C is wound around one pole of a bar magnet N S, and the ends of the coil are connected to the screws S S by means of which they are joined to an exactly similar arrangement at the other end of the line. A circular disc D placed near the magnetic pole vibrates under the influence of the voice as a person speaks into the mouthpiece.

These vibrations cause a variation in the magnetic intensity in the neighbourhood of the coil C, hence induced currents are set up in the line. The variations in these currents cause the disc of the similar receiver at the other end to vibrate in exactly the same way as the transmitter disc.

In some forms of telephone, a current from a battery is modified by means of a *microphonic* transmitter (Fig. 73) in which loose grains of carbon alter the resistance, and hence the current, as they are vibrated by the speaker's voice.

In the wireless telephone an operation similar to ordinary telephone is performed; similar, in that steady *persistent* waves in the æther between two places are modified at the sending station by the speaker's voice. Corresponding variations are produced at the receiving station. L. M. P.

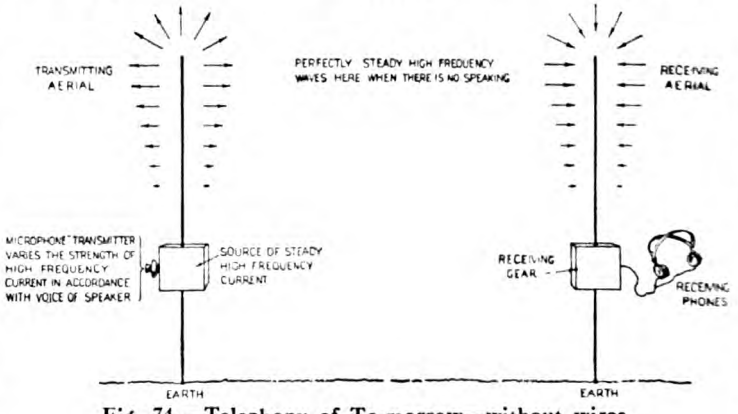


Fig. 74.—Telephony of To-morrow—without wires.

BOTANY.—XIV

39. Use of the Microscope. — When the student has accustomed himself to the habit of observation with the naked eye, he will be prepared to take up the more accurate work that can only be done with the microscope. But it should be said at once that the lessons of the microscope can be intelligently read only by those who have learnt to use their eyes; and the possibilities of observation with a hand-lens should be exhausted before microscopic work is begun. With this proviso, the microscope is an indispensable instrument to the student of botany; there is literally no end to the pleasure and instruction which it affords.

A simple microscope consists essentially of two lenses, the object-glass (*o*) and the eyepiece (*e*), mounted together in a sliding tube which can be brought into suitable position to view accurately and in proper focus an object placed on the stage (*st*). We do not consider here the mechanical accessories for doing this effectively, but for the benefit of beginners in botany assume these, and note the points of greatest interest to them.

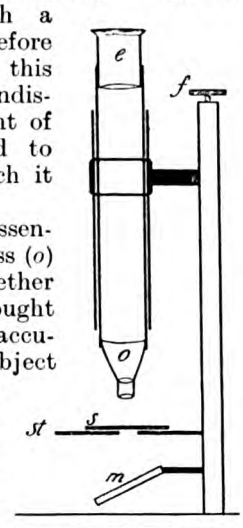


Fig. 88.—Diagram of a Microscope.

***e**, eyepiece; **f**, adjustment screw; **m**, mirror; **o**, object glass; **s**, slide; **st**, stage.*

The object to be viewed is mounted in water or other transparent liquid on a glass slide (*s*) and covered with a square of very thin glass, called a cover-glass. Care must be taken not to let the liquid get on to the object-lens, which is the *raison d'être* of the cover-glass. There are, at least, two object-glasses with a microscope, which we may speak of as the "high-power" and "low-power" respectively.

Objects on the stage should always be observed first with the low-power, which is the lens of wider aperture. A larger field can thus be viewed. If now larger magnification is desired, the slide should be fixed with the interesting portion in the centre of the field; and the microscope-tube having been raised, the object-glasses should be changed. Always lower the tube carefully, especially if it has to be done by hand; it is well to look through the eyepiece as you are doing so, so that the motion can be stopped when the object becomes visible. When the high power is being used, the object-glass is quite close to the slide.

The botanical microscope is provided with a *fine adjustment* (*f*), a screw by means of which a more exact focus can be obtained. In using this screw, the object must be viewed simultaneously with the working of the screw. The most exact focus that can be obtained with the coarse adjustment should be obtained before the fine adjustment is used. Movement of the fine adjustment is often necessary before all parts of the object can be seen; different layers need a different focus.

In this simple form of microscope the coarse adjustment is worked by hand; in better types it is worked by a screw which slides it more easily and exactly. Botanical specimens are usually viewed as transparent objects: hence the need of the mirror, *m*, which reflects the light on to the stage. This mirror must be adjusted by trial; it is movable on a pivot, and should be moved until the whole field seen is bright.

The actual manipulation of the microscope having been carefully learnt, the student may now proceed to make a simple preparation.

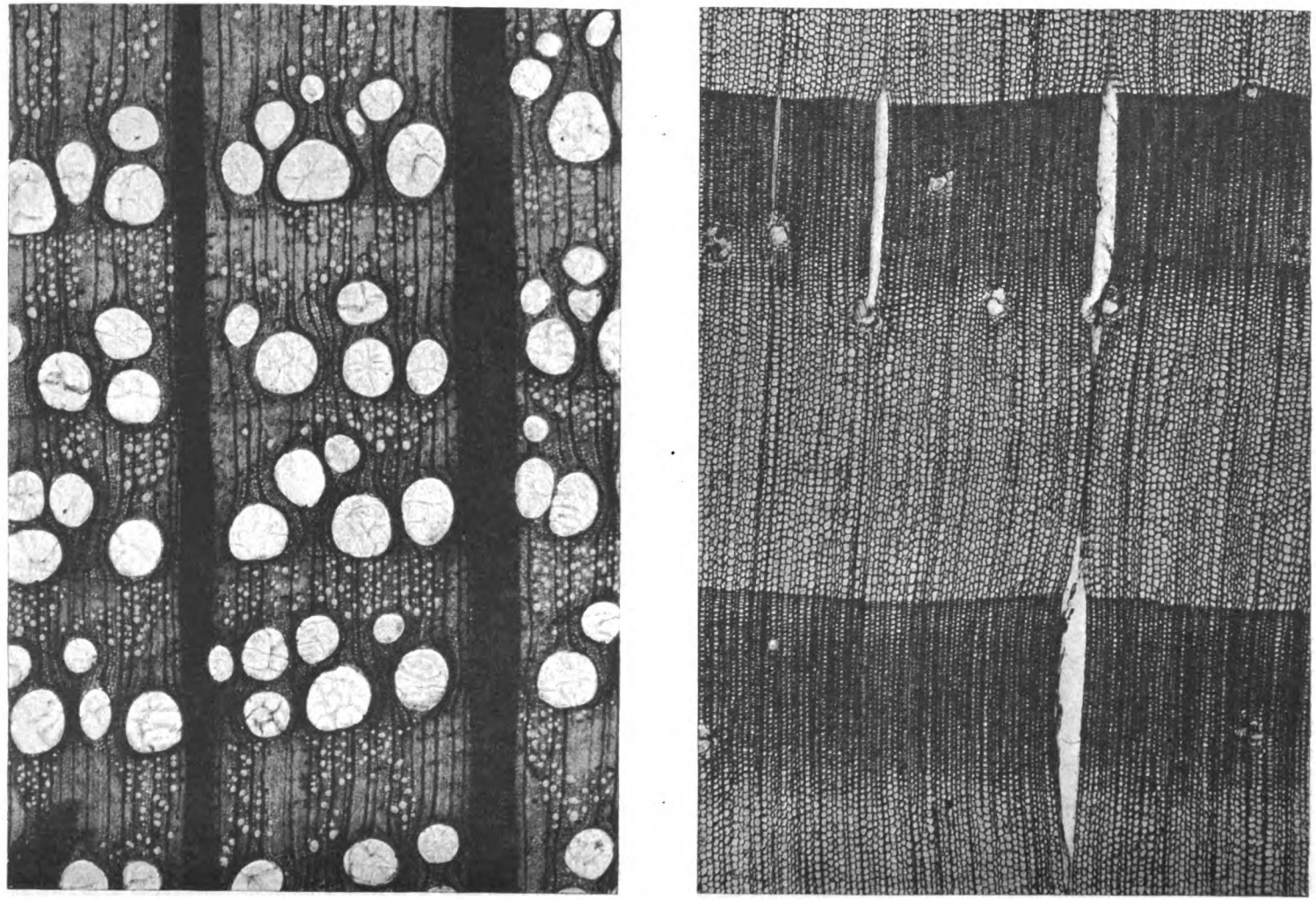
DEMONSTRATION XXVI

Take a perfectly clean and dry slide and cover-glass, and on the centre of the slide place a single drop of water, into which the juice from a potato has been squeezed. Place one edge of the cover-glass on the slide, and support the glass at an angle of 45° with a needle. Let the cover-glass fall gently down on to the drop of liquid.

If any of the liquid is now pushed over the edge or on to the top of the cover-glass, it is best to clean the slide and cover-glass and begin again. The careful procedure in setting up the slide is necessary for this reason, and also to prevent the enclosure of air-bubbles in the preparation.

View the preparation with the low power, so that an accurate general impression can be obtained. It is not necessary to use the fine adjustment for this purpose; a sufficiently accurate focus can be got by means of the coarse adjustment when the low power is used. The potato juice, under this comparatively low magnification, is seen to be swarming with small oval grains. Move the slide without taking the eye from the eyepiece, until you have a few of the larger grains in the centre of the field. Fix the slide with the clips attached to the stage, and examine under the high power. Draw carefully what is observed.

The oval grains are grains of starch, as it is easy to confirm by mounting a drop of the juice in very dilute iodine solution instead of water. By carefully using the fine adjustment, the structure of the grains can be easily made out. They are evidently built up eccentrically round a nucleus, and the lavering is very distinct.



TRANSVERSE SECTIONS OF OAK (left) AND OF SCOTS FIR, OR PINE (right)

magnified 30 times by a photomicrographic process. In order thus to examine the minute structure of plants it is necessary to obtain by means of a razor sections of the finest possible shavings.

Examine in the same way the starch-grains, if any, in the juice of a turnip, an onion, a grain of wheat well-soaked, etc.; in arrowroot; in the latex of the spurge; in fruit-juices, etc. Mount both in water and in iodine. Also note the nature of the grains in potatoes or wheat that have begun to sprout.

In some of these preparations, smaller rounded grains are often to be observed, which stain yellow and not blue, with iodine. These are called *aleurone grains*, and consist of some form of protein.

40. Preparation of a Section.—In order to examine the minute structure of plants in detail, it is necessary to obtain very thin slices or sections, so thin as to be quite transparent. For this purpose a good hollow-ground razor is necessary. Even with good tools and suitable materials, the preparation of such a section is a matter of skill, only to be acquired by practice. A thick section is useless, and a razor is easily ruined by clumsy use.

As general rules, we may say that the object to be cut, and the razor also, should be moistened with water or glycerine (when this liquid is, as often, preferable) before any attempt is made to cut it. The material should be as soft and firm as possible, not flabby or brittle; and special preliminary treatment is sometimes necessary in dealing with flaccid or hard structures. The razor must not be used as a saw, and a steady gentle pressure only is required. The cut should be made towards you, and should finish with a slight upward motion. Probably only the edges of a section will be thin enough to examine properly, and several sections will often be necessary in order to investigate the whole of a structure, such as a stem.

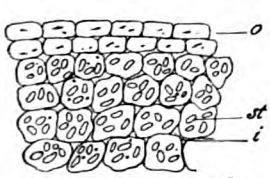


Fig. 89.—Section of a Potato.

o, outer cells containing brown colouring matter; st, starch grains; i, intercellular space.

DEMONSTRATION XXVII

As an example: cut a section of the solid part of a potato, and mount in water or glycerine. Take care to cut several sections on the razor, and transfer them to water or glycerine in a watch-glass. Choose one or two which appear to be thinnest; and mount as described. Examine both with low and high power.

The potato will now be seen to be a *tissue*, made up of many individual compartments called *cells*, in which the starch-grains are enclosed. The cells have each their own wall, which is very thin and fits close to the walls of the neighbouring cells, except at the corners, which, being rounded, do not fit exactly. The *intercellular spaces* thus left are exceedingly important for the aeration of the plant. They are filled with air, and look black in the section.

Examine in a similar way sections of a broad bean, a nut, a Brazil nut, a grain of wheat; taking care that the material is soft enough to cut without injuring the razor. Make the first cut with a clean penknife. Avoid the outer portion, except when you are especially examining that.

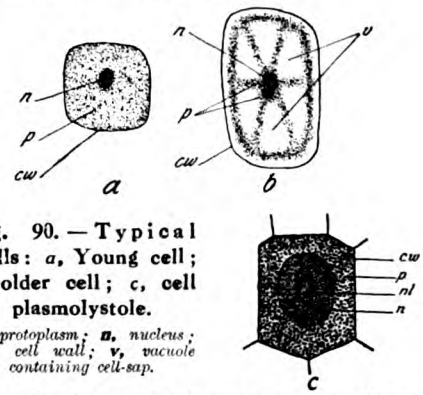


Fig. 90.—Typical Cells: *a*, Young cell; *b*, older cell; *c*, cell plasmolystole.

p, protoplasm; n, nucleus; cw, cell wall; v, vacuole containing cell-sap.

You will often notice in sections perfectly round objects with thick and sharp black edges. These are air-bubbles which have come either during the mounting process, or from intercellular spaces or air-containing cells. They must be ignored in your drawings.

These new examples will show the same general lesson as the potato. The body of the bean or nut is made up of cells of fairly uniform size and shape and thus form a tissue known as *parenchyma* or ground tissue, because it is the fundamental tissue of the plant. All the other tissues of the plant may be regarded as modified parenchyma. For example, the outer cells of the grain of wheat are seen to be flattened and thick-walled, and to contain no starch.

The lesson first to be impressed upon the observer with the microscope is that all parts of the plant are made up of cells.

The contents of the cells vary: Starch-grains and aleurone-grains will be easily shown by iodine in most of them, whilst the Brazil nut is rich in glistening drops of oil.

Every truly living cell contains protoplasm. This is the living matter of the cell, the director of its functions. It may be recognised by its affinity for colour; if a section be mounted in a dilute solution of carmine or methylene blue, the protoplasm is deeply stained by the dye. Under high powers, and in active growing tissues, an oval body called the *nucleus*, which stains still more deeply than the general protoplasm, can be observed. The nucleus guides the reproductive process, and a division of the nucleus is the normal preliminary to the production of new cells.

The study of the nature of the protoplasm

and of the behaviour of the nucleus is one of the most fascinating and most wonderful that can be undertaken with the microscope, but it is too difficult for the beginner.

In addition to protoplasm, the living cell always contains a certain amount of *cell-sap*, the watery fluid which brings it its nutritive substances. Much of this sap is withdrawn if a section be placed in strong salt solution; the protoplasm is drawn away from the cell-walls, and rolls up in a shrunken mass in the interior of the cell. This action is called *plasmolysis*, and can easily be examined.

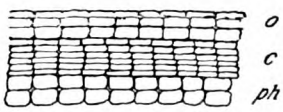


Fig. 91.—Cork Cells.
***ph,** phellogen; **o,** rough outer layer; **c,** cork.*

DEMONSTRATION XXVIII

A section, say, of a growing-point of a stem, should be stained by a harmless dye, and mounted in a strong salt solution. The plasmolysis can then be watched as it occurs. The protoplasm will generally recover if the section is placed again in pure water. It is evident that the salt solution acts by osmosis, drawing the water out of the cell because of the greater dilution of the sap.

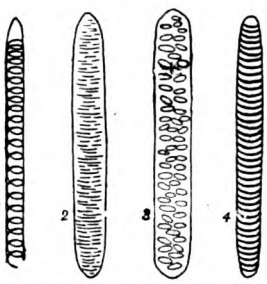


Fig. 92. — Vessels — *i.e.* compound cells formed by the fusion of several cells lengthwise — may be 1, spiral; 2, scalariform; 3, pitted; 4, annular.

The fact of plasmolysis makes it clear that the cell-wall is no barrier to osmosis, and that liquids can thus pass from cell to cell. The importance of this to the plant is obvious. In the normal cell the cell-wall is made of *cellulose*, a carbohydrate which is highly resistant to chemical agents. Under the microscope, cellulose is easily recognised by means of Schultze's reagent, which turns it violet.

41. Modified Cells. — Cells may be modified from the normal type by the accumulation in them of starch, proteins, oils or other substances, to the exclusion of the protoplasm, or not, according to circumstances. But usually the modification is accompanied by the death of the cell, and a thickening of the cell-wall with new substances from the dying protoplasm.

Thus a mass of parenchyma tissue may be changed into *sclerenchyma* by the walls of the cells becoming very thick in proportion to their size. This tissue forms the substance of many of the hard parts of the plant, e.g. the core of an apple or the shell of a nut.

Again, a special modification occurs in the bark of trees. This consists chiefly of cork cells formed by a special layer of the parenchyma, called the *phellogen* or cork cambium. The cork tissue consists of rectangular cells which fit exactly at the corners, without intercellular spaces. The walls of the cells are thickened with the impermeable cork-material, or *suberin*; and the cells themselves are empty.

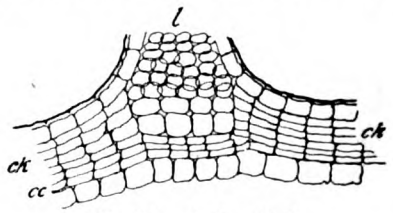


Fig. 93.—A Lenticel.
***l,** lenticel; **cc,** phellogen (cork cambium); **ck,** cork.*

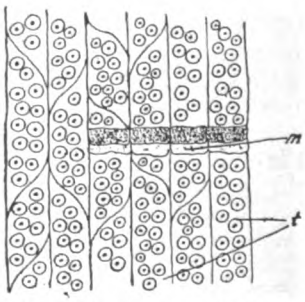


Fig. 94.—Section of Pine.

Wood consists chiefly of vessels, which are really compound cells formed by the fusion of several cells lengthwise. The walls are thickened with *lignin* or wood-substance, and the vessels have no living contents. But provision has to be made for the entrance and exit of water into these vessels. Consequently the thickening is not uniform all over the walls; the lignin is not laid on everywhere; and water can readily permeate the cellulose wall, which is the only boundary between the neighbouring vessels at the unthickened part.

The unthickened parts of the walls may be merely circular or oval holes in the lignin: these holes are called *pits*, and beautiful examples can be observed in pinewood. In other cases the thickening is laid on in spiral fashion, forming a *spiral vessel*; another common case is to find the pits in the form of transverse parallel stripes: such vessels are called *scalariform*.

E. W. E.

MINERALOGY.—VI

We must now continue the examination of the Silicate-minerals which we began in the last lesson.

IX.—SILICATES (*continued from Vol. IV., p.* 463).

9. Pyroxenes.

The orthorhombic pyroxenes are rarely found with good crystal faces, but the cleavages are well developed. Enstatite is grey, through greenish tints to brown, and has often the silky lustre and smooth feel characteristic of magnesium minerals. Bronzite and hypersthene differ in containing Fe replacing Mg. Bronzite is easily recognised by its fibrous structure and bronze-like colour and lustre. Hypersthene is darker in colour and often contains tiny inclusions of other minerals which produce a characteristic "schiller."

The monoclinic pyroxenes are much more abundant, and occur in stout, eight-sided prisms. Diopside is a light green variety, the colour depending on the amount of iron present. When pure it is transparent or translucent in small grains. Augite (*see p.* 461) is black and opaque. *Diallage* is a grey-green variety of augite, which is laminated and which possesses a pearly lustre and schiller like that of hypersthene. Ægirine or acmite is a dark green soda-pyroxene which occurs in elongated crystals and is common in rocks that contain the felspathoid minerals. *Jadeite* is a compact tough greenish soda-pyroxene which, together with nephrite, is known as jade, which is much prized by the Chinese, who carve it into ornaments. The alteration products of the pyroxenes depend upon their composition. Varieties rich in magnesium form bastite, serpentine, and even talc. Those which contain much iron and aluminium change to chlorite. By metamorphic processes augite is sometimes transformed with little change of composition to a fibrous form of hornblende known as *uralite*. Under extreme weathering the pyroxenes break down into limonite and carbonates.

10. The Amphiboles.

Crystals of the amphiboles are usually long and bladed, the black hornblende of certain basic rocks being the chief exception. Tremolite is a white or grey variety which may be soft and fibrous, and is then known as *asbestos*. With increase of iron the colour becomes green, in actinolite. *Nephrite* is a variety of actinolite which is tough and compact, and, as mentioned above, it forms a variety of jade.

Hornblende is dark green to brown and black. Arfvedsonite and riebeckite, respectively brown to black and blue-green to black in colour, occur like ægirine in felspathoid bearing rocks. Glaucophane is a blue and purple variety which only occurs in certain schists and other metamorphic rocks. Crocidolite is a fibrous soda-iron amphibole, often with a beautiful golden colour, due to its oxidation. It occurs in South Africa, where it is largely replaced by quartz, and when cut it is a beautiful ornamental stone, the "tiger's eye" of the jewellers.

Amphiboles alter in much the same way as pyroxenes.

11. The Olivine Group.

The following minerals form an isomorphous series of orthorhombic crystals:—

Monticellite	$CaMgSiO_4$	Sp.gr. = 3·1
Forsterite	Mg_2SiO_4	,, 3·25
Olivine	$(Mg,Fe)_2SiO_4$	,, 3·35
Fayalite	Fe_2SiO_4	,, 4·13
Tephroite	Mn_2SiO_4	,, 4·1

Of these minerals *Olivine* alone is of importance as a rock builder. It rarely forms large crystals, but is common in rocks like basalts and gabbros in green glassy blebs. Clear transparent varieties are used as gems under the name of peridot, and an important group of rocks in which granular olivine is the main constituent is known as the Peridotite group. Dun Mountain, in New Zealand, is made up of green olivine and chromite, the rock being called Dunite. By weathering and oxidation olivine may take on a reddish superficial crust. When bottle green, as it usually is, the lack of cleavage distinguishes it from green pyroxenes.

Monticellite and forsterite are found only in crystalline limestone, as at Vesuvius. Fayalite is readily formed in iron slags, and it occurs naturally in rhyolite and granite, but is very rare. Tephroite (ash-coloured stone) accompanies the zinc and manganese ores of Franklin, New Jersey.

12. Serpentine and Talc.

Olivine is easily altered by thermal waters charged with carbon dioxide, and is transformed to serpentine and iron oxides. Leaving out the iron, a possible change is as follows:—

$$\underset{\text{Forsterite}}{2Mg_2SiO_4} + 2H_2O + CO_2 = \underset{\text{Serpentine}}{Mg_3H_4Si_2O_9} + \underset{\text{Magnesite}}{MgCO_3}.$$

Pyroxenes may be similarly changed:—

$$\underset{\text{Diopside}}{3MgCa(SiO_3)_2} + 3CO_2 + 2H_2O = \underset{\text{Serpentine}}{Mg_3H_4Si_2O_9} + \underset{\text{Calcite}}{3CaCO_3} + \underset{\text{Quartz}}{4SiO_2}$$

In a similar way, the amphiboles and pyroxenes may change to talc—e.g.:

$$\underset{\text{Enstatite}}{4MgSiO_3} + H_2O + CO_2 = \underset{\text{Talc}}{Mg_3H_2(SiO_3)_4} + \underset{\text{Magnesite}}{MgCO_3}$$

$$\underset{\text{Tremolite}}{CaMg_3(SiO_3)_4} + H_2O + CO_2 = \underset{\text{Talc}}{Mg_3H_2(SiO_3)_4} + \underset{\text{Calcite}}{CaCO_3}.$$

Serpentine, $H_4Mg_3Si_2O_9$, occurs in compact slaty or fibrous masses with a smooth, greasy feel. It does not occur in crystals, but, as shown above, it takes the form of the magnesium minerals from which it is produced. The colour is usually green or brown, the shades varying from nearly white to nearly black, according to the amount of iron present and its state of oxidation. The lustre is wax-like. Owing to the frequent presence of inclusions of the original mineral the hardness ($2\frac{1}{2}$–3) and specific gravity (2·2-2·7) are somewhat vari-

able. Fibrous serpentine is used as asbestos, and is called *chrysotile*. It occurs in seams in the otherwise compact mineral. It must be remembered, however, that true asbestos is the fibrous variety of tremolite.

Serpentine may form large rock masses, as at the Lizard, formed from the alteration of peridotites, or it may occur in aggregates distributed in other igneous rocks and also in some magnesium bearing metamorphic rocks.

Talc, $Mg_3H_2(SiO_3)_4$, occurs chiefly in the metamorphic rocks. It is probably monoclinic, but rarely forms distinguishable crystals, being generally in foliated silvery masses, as in talc-schists, or in compact structureless bands. The latter variety is known as *steatite* or *soapstone*, and is used by tailors as French chalk. The colour is silvery white to pale green and grey. The softness (H = 1 to 1½) and soapy feel make it an easily recognised mineral. Both steatite and serpentine are used for ornamental purposes, being soft and easy to work, and not liable to further decomposition.

13. Chondrodite.

There is an interesting group of minerals which is closely allied to olivine, but which contains fluorine and hydroxyl. The members, which cannot readily be distinguished, are as follows:—

Chondrodite	$(MgF,MgOH)_2\ Mg_3(SiO_4)_2$	Monoclinic
Humite	$(MgF,MgOH)_2\ Mg_5(SiO_4)_3$	Orthorhombic
Clinohumite	$(MgF,MgOH)_2\ Mg_7(SiO_4)_4$	Monoclinic

and they may be regarded as $(MgF,MgOH)_2Mg\ SiO_4$, combined with one, two, and three molecules of forsterite respectively. As in olivine, magnesium may be replaced by ferrous iron.

Chondrodite is a yellow, red to brown transparent or translucent mineral, with a vitreous lustre. H = 6 to 6½; sp. gr. = 3·1 to 3·2. The crystal forms are not often developed, granular masses being more common. The other two members of the group are very similar, and all three are found in ancient crystalline limestones and dolomites.

14. The Micas.

The micas form a natural group of closely related minerals which all crystallise in nearly hexagonal plates, belonging, however, to the monoclinic system. They all have a very perfect basal cleavage, and readily split into thin, tough, flexible and elastic flakes. The hardness lies between 2 and 3, so that they can easily be scratched with a knife. For practical purposes the micas are divided into the light-coloured varieties, of which muscovite is the type, and the dark-coloured varieties, of which biotite is the type. They may all be regarded as derivable from an ideal molecule, $Al_4(SiO_4)_3$, combined in some cases with a certain amount of $Al_4(Si_3O_8)_3$. The normal compositions are as follows:—

Varieties of Mica	*Name*	*Composition*	*Sp. gr.*
	LIGHT-COLOURED MICAS		
Potash-mica	Muscovite	$Al_3KH_2(SiO_4)_3$	2·85
Soda-mica	Paragonite	$Al_3NaH_2(SiO_4)_3$	2·9
Lithia-mica	Lepidolite	$Al_3KH_2(SiO_4)_3{\cdot}(AlF_2)(Li,K)_3Si_3O_8$	2·8 to 2·9
	DARK-COLOURED MICAS		
Magnesian mica	Phlogopite	$AlMg_3KH_2(SiO_4)_3$	2·75
Ferro-magnesian mica	Biotite	$Al_2(Mg,Fe)_2KH(SiO_4)_3$	2·9
Iron-mica	Lepidomelane	$(Al,Fe)_2(Fe,Mg)_2KH(SiO_4)_3$	3·0
Lithia-iron-mica	Zinnwaldite	$Al_2Fe(SiO_4)_2{\cdot}(AlF_2)(Li,K)_3Si_3O_8$	2·97

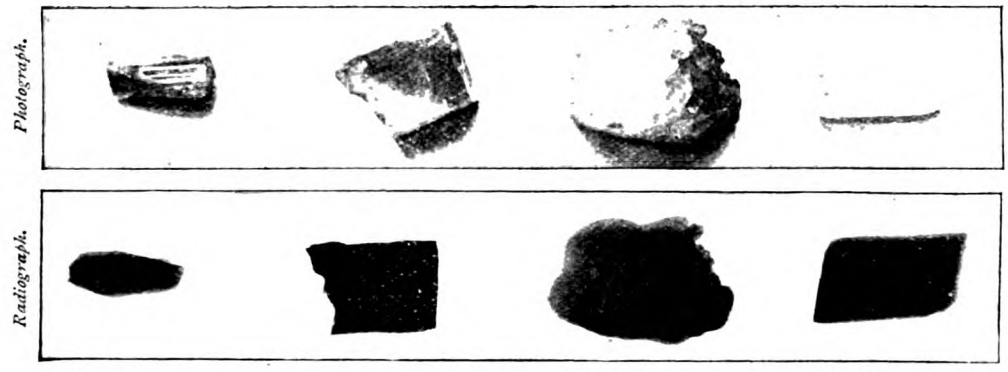
15. Muscovite.

Muscovite is colourless, but when seen in thick masses it may have a grey, buff, or green tint. Six-sided tablets are often found in pegmatites, but usually muscovite and all the other micas are found in shapeless flakes and shreds. Muscovite sometimes occurs in sheets which may be a yard or more across. Large cleavage flakes are used for many purposes where glass would be unsuitable, as in furnace doors and windows. It is also used for stoves, and lamp chimneys and shades, for insulating electrical apparatus, for frosting, and as a lubricant when finely ground. It occurs in granites and pegmatites, but not in volcanic rocks. In gneisses and schists it is a very important mineral in company with biotite. Owing to their perfect cleavage and flexibility the micas are able to accommodate themselves to the high pressures of metamorphism, and are, in fact, formed from aluminium silicates of all kinds. *Sericite* is a very fine silky variety formed from felspars, etc., by hydrothermal alterations, and a common constituent of sedimentary rocks and especially shales and slates. Muscovite is a very stable mineral, and, once formed, does not readily decay.

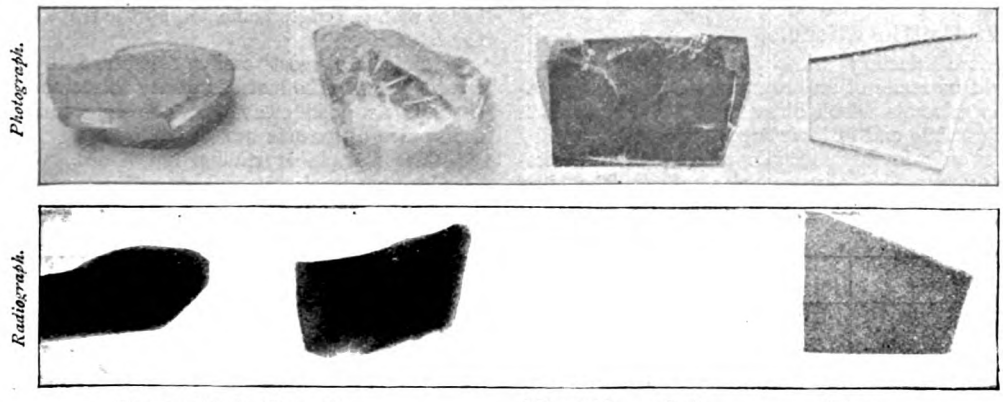
Paragonite is a white soda-mica which only occurs in metamorphic rocks. Lepidolite is a beautiful pink or lilac-coloured mica found in granites and pegmatites in constant association with tourmaline. Crystals are very small, and the mineral generally occurs in massive, scaly aggregates.

16. Biotite.

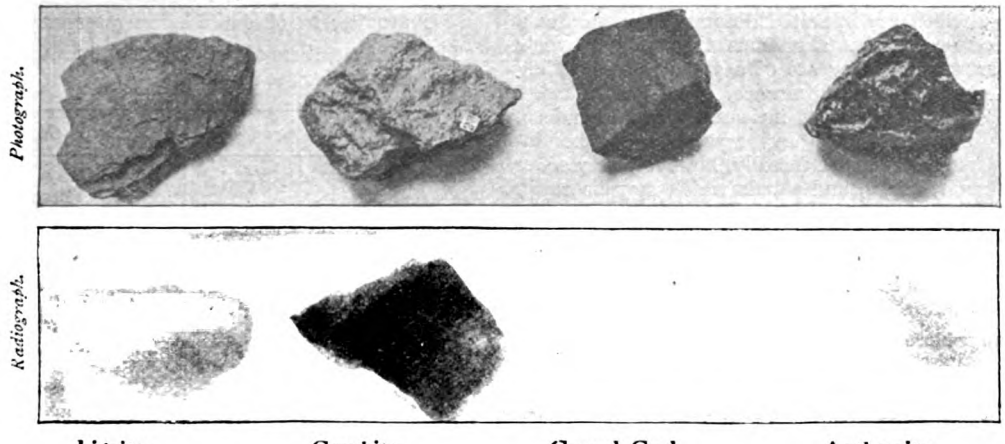
Biotite is the commonest of the micas, being a widespread constituent of many igneous rocks, gneisses, and schists. In colour it is frequently black, and thin flakes are seen to have brown, red-



Topaz. Barytes. Fluor Spar. Iceland Spar.



Quartz (Rock Crystal). Mica (Muscovite). Glass.



Lignite. Graphite. Cannel Coal. Anthracite.

PHOTOGRAPHS AND RADIOGRAPHS OF MINERALS, ETC.

which serve to demonstrate some very striking contrasts in transparency and opacity.
See also p. 3, paragraph dealing with X-rays.

brown, and greenish tints. *Phlogopite* is a variety containing little or no iron, and is consequently paler in colour, a coppery tint being characteristic, straw-coloured in thin flakes. It occurs chiefly in metamorphic limestones. At the other extreme is *Lepidomelane*, a highly ferriferous biotite of very dark colour, which is found in some granites and pegmatites.

Owing to the liability to alteration, these minerals do not, like muscovite, persist in the sedimentary rocks formed from the igneous and metamorphic rocks in which they originally had their home. By hydration the alkalies are lost and a series of ill-defined minerals called *Vermiculites* are formed: e.g. Biotite, $Al_2(Mg,Fe)_2KH(SiO_4)_3$, forms a vermiculite of the type $Al_2(Mg,Fe)_2H_2(SiO_4)_3 3H_2O$; and this in turn, by further change, becomes a soft green chlorite of the type $Al_2(Mg.OH,FeOH)_4H_2(SiO_4)_3$.

17. Brittle Micas.

Before dealing with the chlorites, mention should be made of an intermediate group of micaceous minerals which differ from the true micas in being brittle and in their superior hardness. They occur only in metamorphic rocks, and are noteworthy for the absence of alkalies. The chief members of the group are:—

Name	*Composition*	*H*	*Sp. gr.*	*Colour*
Margarite ..	$Al_4CaH_2(SiO_4)_3$	4	3	Pearly-white.
Chloritoid ..	$(AlO_2)(AlOH.H)(Fe,Mg)SiO_4$ ..	6½	3·5	Grey-green.
Ottrelite ..	$(AlO_2)(AlOH.H)(FeMn)Si_3O_8$ ..	6½	3·3	Green-black.

18. The Chlorites.

The chlorites are a group of complex minerals, all of which are hydrated decomposition products of ferro-magnesian aluminous silicates. As their name signifies, they are of a green colour. They are micaceous in appearance, but differ in being soft (H = 2 to 2½) and inelastic. Like the micas, they are monoclinic and crystallise in pseudo-hexagonal tablets. Generally, however, they occur in leaves, scales, and shreds which may be easily separated along the cleavage, which is not, however, so perfect as in the micas. Chemically the chlorites are very complex, but they may probably all be regarded as isomorphous mixtures of the following types:—

Clinochlore } $Al_2(MgOH.FeOH)_4H_2(SiO_4)_3$.
Penninite } $Al(MgOH.FeOH)_6H_3(SiO_4)_3$.
Prochlorite $(AlO_2)(Fe,Mg)(MgOH.FeOH)H_2SiO_4$.

The sp. gr. varies from 2·6 to 3.

Clinochlore is perhaps the commonest variety of chlorite, and occurs in chlorite schists. Both it and penninite are essentially magnesian chlorites. *Penninite* is remarkable in having a rhombohedral habit. *Prochlorite* is rich in iron, and is sometimes found in curious worm-like masses. All the chlorites occur in schists and as secondary minerals lining cavities and veins in igneous rocks. Altered igneous and other rocks (e.g. slates) generally owe their green colour to the presence of chlorite.

For most purposes it is sufficient to determine any mineral of this group simply as chlorite, for varieties are generally extremely difficult to diagnose with accuracy. Indeed, this difficulty often extends itself to green secondary minerals as a whole, and for this reason, the non-committal term *Viridite* has been used to cover such materials.

Magnetite and garnet are minerals commonly associated with chlorite in schistose rocks; but in amygdales (the mineral-filled gas cavities of volcanic rocks) chlorite accompanies such minerals as zeolites, forms of silica, and calcite.

19. The Garnets.

We now turn to a very different group of minerals. The garnets are a well-defined isomorphous series of cubic minerals, all of which are generally well crystallised in trapezohedra or in rhombdodecahedra with the edges truncated by the trapezohedra faces.

Garnets are most easily recognised by their crystal form. The lustre is glassy to resinous, and there is no good cleavage. The chief modes of occurrence of garnets are as follows:—

Grossular, in crystalline limestones.
Pyrope, in olivine and serpentine rocks.
Almandine, in granites, gneisses, and schists.
Spessartite, in granite and quartzite (rare).
Andradite, in felspathoid rocks.
Uvarovite, in chromite-bearing serpentine.

The chief members of the garnet family recognised as distinct species are as follows:—

Name	*Composition*	*Sp. gr.*	*Colour*
Grossular	$Ca_3Al_2(SiO_4)_3$	3·5	Grey to brown.
Pyrope ..	$Mg_3Al_2(SiO_4)_3$	3·7	Deep red to black.
Almandine	$Fe_3Al_2(SiO_4)_3$	3·9	Brown-red to black.
Spessartite	$Mn_3Al_2(SiO_4)_3$	4·2	Red to brown.
Andradite } Melanite }	$Ca_3Fe_2(SiO_4)_3$	3·8	Red-brown to black.
Uvarovite	$Ca_3Cr_2(SiO_4)_3$	3·5	Emerald green.

The hardness varies from 6½ to 7½.

All the garnets are characteristic minerals of metamorphic rocks. Clear, well-coloured varieties of garnet are used as gems, e.g. carbuncle, cinnamon stone, demantoid, and Cape ruby. See § 28, p. 76 of this volume.

Garnets often occur in ore-deposits developed at or near the contact of igneous rocks with calcareous rocks, copper ores being those commonly associated with this type of gangue. A. H.

ANATOMY AND PHYSIOLOGY. VIII

We have seen that the blood is the source from which the muscles draw their fuel and their oxygen, and into which they discharge their waste products. Now waste products are poisons.

It is clear that if the blood were stagnant, if the same lot of blood was always in contact with the same muscles, all the food in it would get used up, and it would be overfilled with waste. Each part of the tissues wants a fresh supply of blood. There is no arrangement in the body whereby a continuous supply of blood can be poured in at one end of the body and poured out at the other, as is done with food. The same lot of blood is used over and over again, and fresh ingredients are added, and used up materials removed as required.

Blood Circulation

The method by which this is made possible is the *circulation* of the blood. The blood is contained in a closed system of tubes, parts of which are thin enough to allow exchange of food and oxygen and waste materials to take place between the blood and the tissues. The movement of the blood along these tubes is due to a pump, the heart, which is included in the circuit of tubes.

The principle of the circulation can be understood by making a model with india-rubber tubes, as follows: A Higginson's syringe is used in many households for domestic purposes (Fig. 1). It consists of a long rubber tube in the middle of which is a rubber ball. There are valves in the tubes which only allow water to flow along the tube in one direction. Place the inlet end in water and squeeze the ball. You squeeze the air out of the ball, and when you relax, it swells up again, and draws up water. Squeeze again, and the water is forced out of the nozzle.

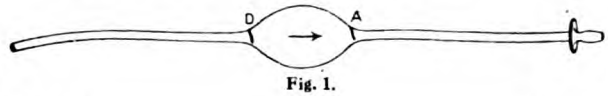


Fig. 1.

Now fill your ball, and put the nozzle into the inlet hole at the opposite end, thus forming a circuit. If your tube is long enough, you will be able to drive the water round and round this circuit. The circulation of the blood is merely a complication of this principle (Fig. 2).

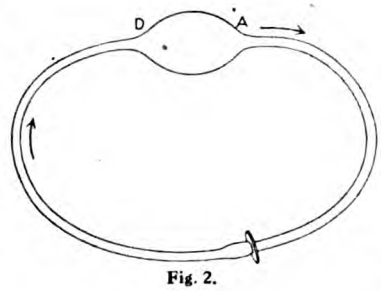


Fig. 2.

Suppose the outlet tube from your syringe divided into two, and joined up again before reaching the inlet, the principle of your circuit would not be altered. Suppose your inlet divided not once but many times, and the division joined up again as before. The convolutions necessarily would appear more complicated, but there would be no change in principle (Fig. 3).

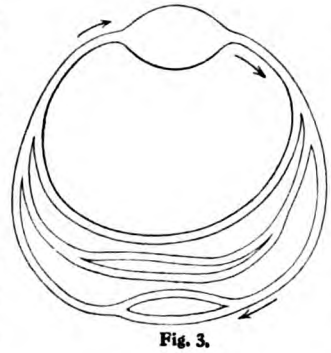


Fig. 3.

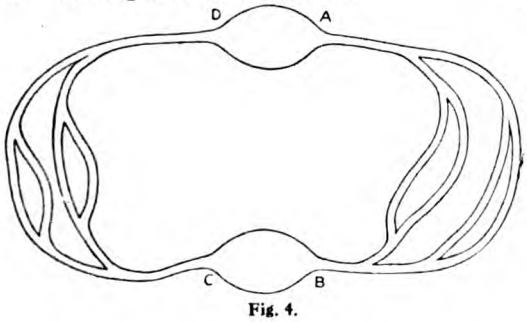


Fig. 4.

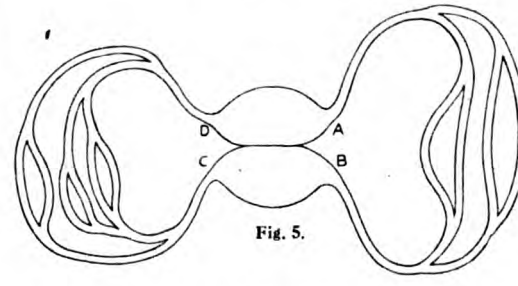


Fig. 5.

A Simple Demonstration

What follows is a little more complicated. Suppose you had *two* Higginson's syringes forming one circuit, the outlet of one discharging into the inlet of the other, and suppose these tubes were also much branched, but all the branches joined up again before reaching the balls (Fig. 4). The principle is still the same. And suppose, finally, that the two balls were placed close together and

bound up so as to form one organ, the circulation would go on just the same, without change of principle (Fig. 5).

This is the principle on which the circulation works, the only other thing to be remembered being that in the heart the inlet and outlet are not placed at opposite ends of the pump as they are in a Higginson's syringe, but very close together (Fig. 6).

A reference to the diagrams will make the arrangement clear.

In the original Higginson's syringe the outlet from the ball is called A and the inlet D. In the fourth, the inlet is B and the outlet C, so that the water flows from outlet A to inlet B; outlet C to inlet D. It is the same when the syringes are close together. But in the heart the inlets B and D are placed close together at the top, and the outlets A and C further down.

The circulation really consists of two pumps and systems of tubes, each discharging into the other. The two pumps are spoken of as the right and left sides of the heart.

The left side is the stronger of the two, and sends blood all through the body except the lungs. It goes to the intestines where fresh digested food is absorbed into the blood; it goes to the muscles where the food and the oxygen are used up and waste products are received; it goes to the kidneys where some of the waste products are got rid of.

Systemic Circulation

The left heart and *systemic circulation*, as it is called, therefore absorb and distribute food, dispose of nitrogenous waste, and distribute oxygen. But they do nothing to absorb oxygen or dispose of carbon dioxide which occurs in the *lesser* or pulmonary circulation, which goes through the lungs. In the capillaries of the lungs the blood is exposed to air, takes up oxygen, and gives up carbon dioxide.

The two sides of the heart are made up on the same plan. The heart is chiefly made of muscle which is said to have the power of *rhythmical contraction*. This means that all through life, from birth till death, the heart keeps on regularly beating, contracting, and relaxing, contracting and relaxing, without a moment's pause.

Each side of the heart consists of two chambers: the *auricle* above, into which the blood enters from the veins, and the *ventricle* below, out of which it is forced into the arteries. The walls of the auricles, which only have to receive blood and pass it on to the ventricles, are quite thin, but the walls of the ventricles are very stout, for they have to pump hard enough to force the blood all through the circulation and back to the heart.

There are *valves* between the auricles and ventricles. The valves are arrangements for directing the flow of blood, allowing it to pass in one direction only, and not the opposite. The valves consist of triangular flaps inside the heart which hang down into the ventricle from the junction of the auricle and ventricle. When the ventricle is relaxed, between the beats, the edges of the valves are separated and the blood can pass through. During the heart-beat the edges of the valves are pressed together so that the blood cannot go back into the auricles, and must go into the aorta. In the aorta there are also valves, though different in structure, which allow blood to flow into the aorta during the beat, and prevent it falling back into the ventricle during relaxation.

Systole and Diastole

The contraction of the heart is called the *systole* (pronounced siss-toly, accent on the siss), and the relaxation is called the *diastole* (accent on the *ast*).

Now let us follow the course of the blood throughout the complete round of the circulation, starting from the left ventricle. The blood has then just been through the lungs and is charged with oxygen, and is bright red in colour. Some of it has been through the intestines and so is charged with food, and some has been through the muscles and so contains nitrogenous waste.

This blood enters the aorta and is distributed through the body. Part goes by the innominate artery and the left common carotid and subclavian arteries for the nutrition of the upper limbs and head.

The brachial artery gives off muscular branches which supply the biceps and other muscles. The muscular branches to the biceps enter that muscle and divide up among its fibres. After many divisions the branches are now only one cell thick, and form the capillaries. The capillaries form a network in and out among the muscle fibres, and when the muscles contract they absorb oxygen from the blood and give off carbon dioxide and some nitrogenous waste, and this enters the lymph and then passes into the capillaries.

The capillaries join together to form thicker vessels called *venules*, and these join together to form veins. Some of these lead into large veins which run alongside the brachial arteries, and others into the large veins just

below the skin which you can see when the arm is bare. These in turn open either into the brachial or subclavian veins. The subclavian veins lead ultimately into the superior vena cava, and so the blood enters the right auricle.

The blood in the aorta which goes on past the arteries for the head and arms and on into the abdomen is partly distributed to the intestines and kidneys.

Several important branches go to the intestine, where they break up into capillaries and unite again into veins just as in the limbs. The capillaries in the intestines are surrounded by lymph which is overfilled with water and salts and digested food, and these pass into the capillaries. The veins of the intestine are peculiarly arranged, as will be seen later. They unite into one vein called the portal vein, and this enters the liver and there breaks up into capillaries a second time. These second capillaries join up again into veins which lead into the inferior vena cava, which also leads into the right auricle.

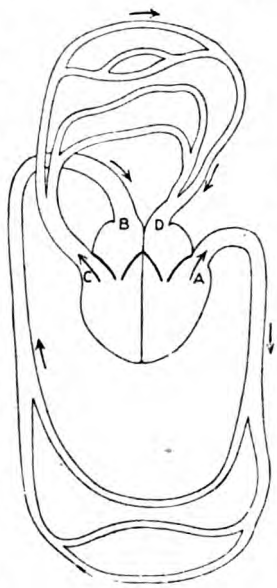


Fig. 6

The arteries to the kidneys, called the renal arteries, enter the kidneys and break up into capillaries, which join again into veins in a similar way. The capillaries pass round the kidney cells, which have the special power of taking water and salts and nitrogenous waste out of the blood, and the blood enters the renal veins the poorer by so much of these things. The renal veins discharge into the inferior vena cava, through which this blood also enters the right auricle.

The blood has now completed the systemic circulation. It has lost oxygen in the muscles, and has lost water and nitrogenous waste in the kidneys, and has gained water and food in the intestines, and has gained carbon dioxide.

From the right auricle it enters the right ventricle, and leaves the heart by the pulmonary artery, which divides into two branches, one for each lung. These break up in just the same way into capillaries which are distributed round the air balloons of the lungs. The whole of this arrangement is to allow the carbon dioxide to escape from the blood and fresh oxygen to be taken up.

The capillaries lead into the pulmonary veins which open into the *left* auricle, with their blood charged with oxygen and freed of carbon dioxide. The blood passes from the left auricle to the left ventricle, ready to complete the circulation again.

The whole circulation depends on the heart-beat, and the heart-beat produces pressure on the blood it contains. It should be noted that the whole circulatory system is full of blood; there is no air in the blood-vessels, in fact, if any gets in, as may happen if the veins of the neck are wounded, the result is generally fatal.

In the capillaries a slow and steady flow of blood is required, but in the arteries there is a jerky flow, due to the heart-beat. How is the jerky flow in the arteries converted to the steady flow in the capillaries?

It occurs in this way. As the arteries keep on dividing, their branches get narrower and narrower, and in the capillaries are very narrow indeed, and these narrow passages offer great resistance to the passage of the blood; the blood is inclined to stick in the narrow tubes. So when the heart beats, and forces blood into the arteries, it is held up for a moment by these narrow spaces.

Now the arteries contain elastic and also muscle, and when the heart beats and the blood is thrown into the arteries and is there held up, the arteries stretch owing to their elastic. Between the beats the elastic in the arteries recovers, and with the muscle in the arteries produces a pressure on the blood between the heart-beats, and in this way the jerky flow in the arteries is changed into a steady flow by the time the capillaries are reached.

The pulse which you feel in the arteries is the hardening of the vessels which occurs when the pressure is raised in them by the heart beat.

As to the contraction of the heart itself; both sides, right and left, contract at the same time. The contraction begins in the veins just before they enter the auricles, so there is no need of valves to prevent the blood flowing back from the heart into the veins. Then the auricles contract and force the blood through the auriculo-ventricular valves into the ventricles; the ventricles contract, the auriculo-ventricular valves close, the aortic and pulmonary valves open, the blood passes on, and the valves close. D. W. C.-J.

ZOOLOGY.—XXVI

ALLIED to the Octopus is the picturesque Argonaut or Paper Nautilus of the family *Argonautidæ*, of which there are four known species all inhabiting the open sea and favouring the warmer parts of the globe. In this family the male resembles the Octopus in that it is without a shell, but the female, some days after she is hatched, secretes a shell which she uses as a vehicle for carrying her eggs. The Argonaut has eight arms, two of which expand into membranous discs at their extremities. This fact for some time misled the naturalist, and furnished the poet with a happy theme for his verse.

The Argonaut, it was held, floating in his shell, hoisted his membranous sails, and driven by a favourable wind sailed merrily away. The picture was pleasing enough and, as has been said, the poets made the most of it. Subsequently naturalists entirely disproved this ingenious suggestion and advanced the theory that the true function of the membranous arms was the secretion of the creature's shell.

Squids and—

The Squids are members of the *Decapoda*, a ten-armed branch of the *Cephalopoda*, for to the eight arms of the Octopus they add two tentacles greatly elongated and expanded at the extremities. The length of these additional tentacles appears the greater by contrast with the eight ordinary arms, which are shorter than the body, and comparatively shorter than those of the Octopus. They serve both to secure the animal's prey, and to moor it to some floating object during stormy weather. The suckers are distributed over the entire length of the ordinary arms, and at the widened extremities of the two elongated tentacles.

The Common Squid is found in numbers off the Cornish coast. Its body is cylindrical, tapering behind and much elongated in the males. The fishermen, who make use of the Squid for bait, have an expressive name for this creature—they term it the "Pen and Ink" fish, from the resemblance borne by the internal shell to a quill pen, and the readiness of the Squid to squirt his inky fluid at any and everything when alarmed.

The rapacious habits of the young Squids are noted by Mr. Henry Lee, who had several of these creatures under observation. "I have seen one in single combat with a young dog-fish about four inches long. At first I thought the fish was the aggressor, and had seized one of the tentacular arms of the little *Loligo* as a good substitute for a worm; but it was soon apparent that the affray had been provoked by the carnivorous *Cephalopod*, and that the puppy-fish would get the worst of it."

The size attained by the adult Squid of some species rivals the efforts of the novelist. One captured off the Irish coast in 1875 is said to have measured something like forty feet from the tip of the tail to the end of the tentacular arms. Even this monster, however, fails to reach the estimated proportions of the colossal creature which attacked two men who were fishing from a small boat off Great Belle Island, Conception Bay, in 1873. From one of the amputated arms which was preserved Professor A. E. Verrill has estimated the entire length of the creature, including its arms, to have been no less than sixty feet.

—Cuttle Fish

The Common Cuttle-fish is the best-known of the Molluscs rightly entitled to be described as "Cuttle-fish." For though the name applies only to the family *Sepiidæ*, it is often loosely given to the Octopus and the Squid. The real Cuttle-fish is generally a much smaller creature than the species with which it is confounded, and seldom exceeds eighteen inches in length. The Cuttle-fish is found round the shores of Britain, being more general in the South. It is exceedingly rapacious, and is fond of hunting during the daylight hours.

The partiality of the Cuttle-fish to light is curious when contrasted with the habit of the Octopus, which rarely stirs except at night. The Octopus will retreat from the light of a lanthorn, but the Cuttle is attracted by it. The ink squirting powers of this Mollusc are highly developed and are used upon the slightest provocation. As evidence of the rapidity with which the ink is secreted, Mr. Lee remarks that he has often seen a Cuttle completely spoil in a few seconds all the water in a tank containing 1000 gallons. The ink of the Cuttle, it is interesting to note, is the true "sepia" of artists.

A very important class of the *Molluscs* is that known as the *Gastropoda*, which includes all the Snails, terrestrial, aquatic and marine, the Whelks, the Limpets and kindred species. In these creatures we find a distinct head which is furnished with one or two pairs of important sense organs usually called the "horns." Upon these

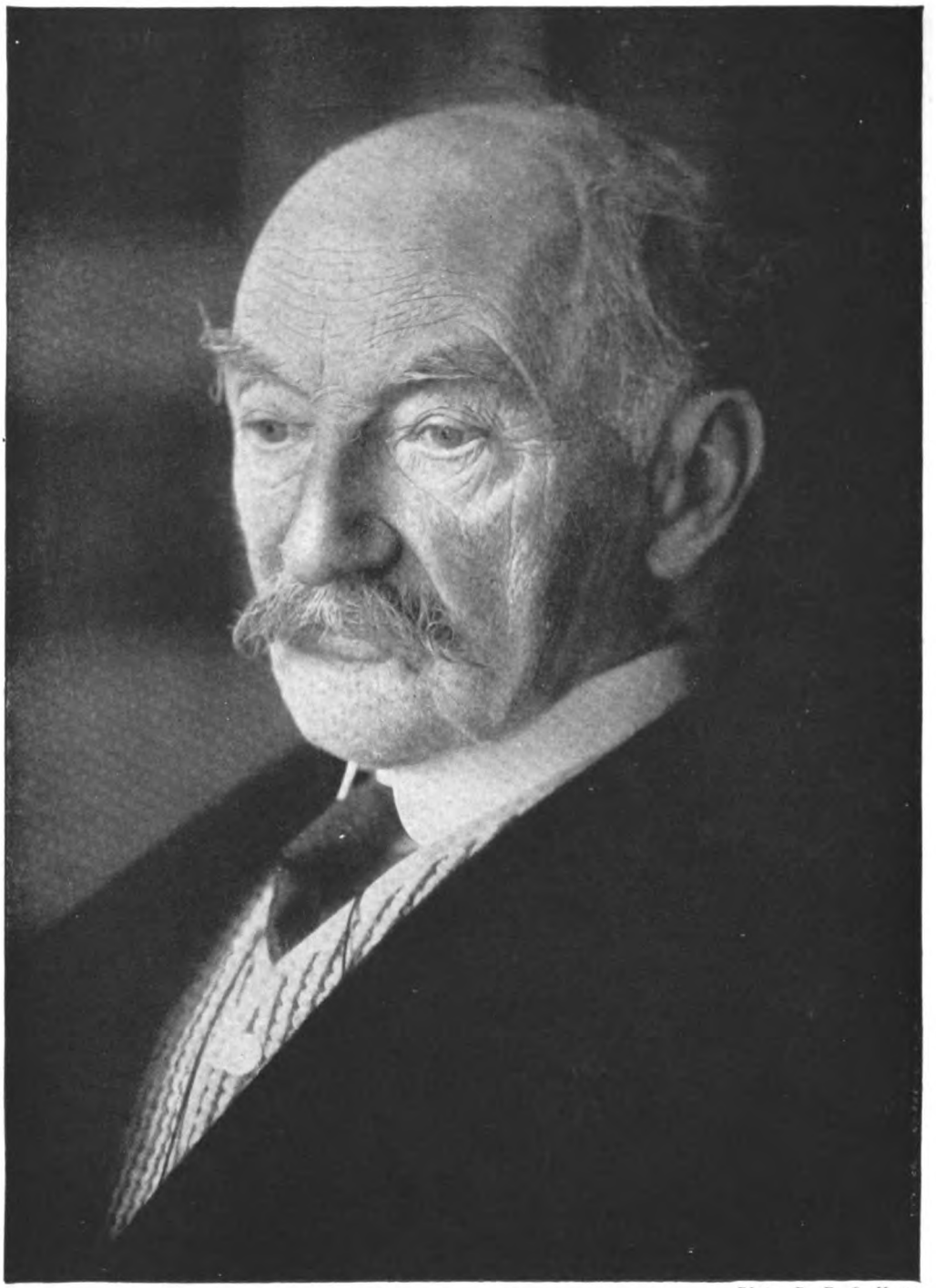


Photo: By E. O. Hoppe.

THOMAS HARDY, O.M.

Poet and novelist (born June 2nd, 1840), who has made modern Wessex as surely known in literature as ancient Wessex is known in history.

" horns " may generally be found the eyes, sometimes placed near the base, occasionally half-way up, and at times, as in the case of the Common Snail, at the top. The shells of many of these species are delightfully coloured, and in most instances are furnished with a curious form of door to which the name " operculum " has been given.

In the case of some Land Snails, however, the intention of the operculum is served by a number of projecting teeth which effectually prevent the ingress of enemies. The operculum differs in substance from the shell proper, and is controlled by a muscle upon the inner side. All the *Gastropoda* move by successive expansions and contractions of the under-side of the body. Some idea of the immense variety of species concerned may be formed from the most recent estimate of their number, which reaches no less a total than 40,100.

Whelks and Limpets

The Whelk belongs to a class of carnivorous *Gastropoda* in which the shell mouth is notched in front. It is furnished with sharp lingual teeth for boring into shells, and a long proboscis-like mouth and siphon which is used to extract its prey, and for the purpose of breathing when the body of the animal is below the surface of the mud or sand. Before proceeding to drill a hole in its victim the whelk (who is very partial to an oyster lunch) first fixes itself firmly on the shell by means of its great foot. Vast quantities of this creature are taken round the coasts of Britain and Ireland for use as bait and food.

The Periwinkle frequents the coast line, where it feeds upon various algæ. If one of these creatures is examined it will be seen that the under part of the body is cleft longitudinally, permitting forward movement by the alternate lifting and advancing of the two halves.

The Limpets are found in several families, all of which are strongly adhesive. To find these creatures it is necessary to examine the rocks between high and low water marks. All Limpets are vegetable feeders, and after feeding they return to the same spot. To such an extent is this the case that even hard rocks will be found to be worn to a smooth cavity beneath the spot in which they rest. Over one hundred living species of Limpet have been classified, and they exhibit greater variety of form than is generally supposed. The Limpet of the west coast of South America, which is a foot in diameter, is quite calculated to astonish people who are familiar only with the Common Limpet of our own shores.

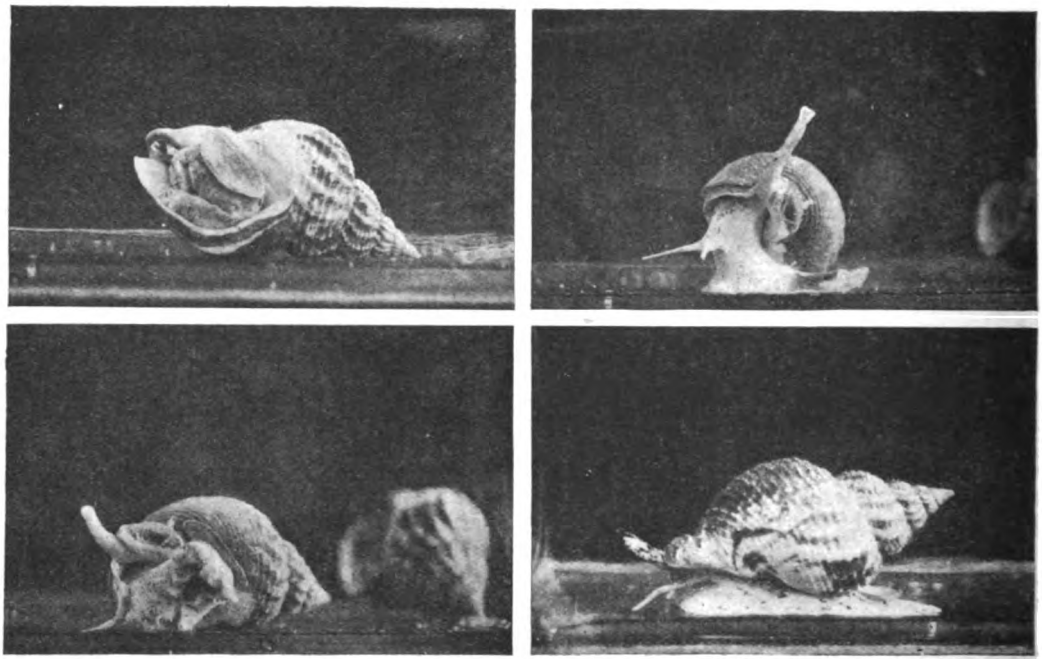
The Land Snails in the person of the Common Snail are familiar to everybody. The shell which plays so large a part in our recollections of these creatures is so well developed as to make entirely truthful the old adage about the creature that carries its home upon its back. Not only does the resident retire into this house during the dry season, but where extremes of heat and cold are anticipated it closes the entrance by one and sometimes two distinct partitions, leaving only an infinitesimal hole through which to breathe.

Snails and Slugs

The eyes of this creature are placed at the summit of the longest tentacles or horns, and breathing is effected through an opening which occurs on the right side beneath the margin of the shell. The *Helicidæ* are almost exclusively vegetable feeders, subsisting chiefly upon leaves. Both sexes are combined in the same individual. It is the common lot of snails to form food for animals greater than themselves — the *H. Arbustorum* and the *H. Aspersa* especially, are devoured in great quantities by blackbirds and thrushes; but for this fact they would exist in much greater numbers than at present, since the Snail is comparatively long-lived and is very tenacious of life in adverse circumstances.

The Slugs of the family *Lamacidæ* are without shells, but in other respects greatly resemble the Snails. In some species a small shell plate may be found hidden beneath the skin of the back. These creatures shun the light of day, and indulge their voracious appetite at night. Most species may be found in gardens and hedges in damp places or under cellars and outhouses, but one species, the *Testacella*, burrows into the ground to the depth of from two to three feet and there lives upon worms.

Molluscs such as the Oyster, in which there exists neither head nor jaws, constitute a distinct class, which has been variably styled *Conchifera*, *Pelecypoda* and *Lamellibranchia*. In these creatures the shell consists of two plates, which are secured to each other on one side by an elastic substance called the " ligament." From these plates or valves arises the name Bivalves applied to these Molluscs. Most bivalves are sedentary in their habits, and feed in an exposed or buried condition upon the minute par-



Photos: F. Martin Duncan, F.R.P.S.

THE WHELK: SHOWING HOW IT EXPANDS ITS FOOT.

A voracious, carnivorous feeder, the whelk uses its great foot to fix itself on the shell of its victim, and then proceeds to bore a neat hole by means of its sharp lingual teeth.

ticles of animal or vegetable matter contained in the water. Breathing is effected by means of lamellæ or leaf-like gills placed on each side of the body.

Where the adult bivalves are devoid of the power of self-propulsion the embryos of the species are nearly always, for a time, free swimmers. Each young Oyster is enclosed in a transparent shell which is provided with a fringe of cilia with the assistance of which it swims away from the parent shell. Some forty-eight hours later it settles and adheres to the rocks of the sea bottom, the celia are lost and the Oyster becomes for the rest of its life a sedentary creature. How long this life may be is only roughly known, though it is thought that the Oyster attains its full growth in five years and lives upon some Oyster beds for ten.

Pearl Fisheries

In the "Pearl Oysters" the shell is heavy and very oblique, and the valves are of unequal size. The inside of the shell is lined with very thick "Mother-o'-pearl." Hundreds of tons of these shells are collected annually at the pearl fisheries of North and West Australia to provide the market with this useful substance which is used in the manufacture of buttons, and for inlaid work. The pearl, however, as distinct from the substance termed "Mother-o'-pearl," is obtained from the small Pearl Oyster (*M. vulgaris*) of Ceylon.

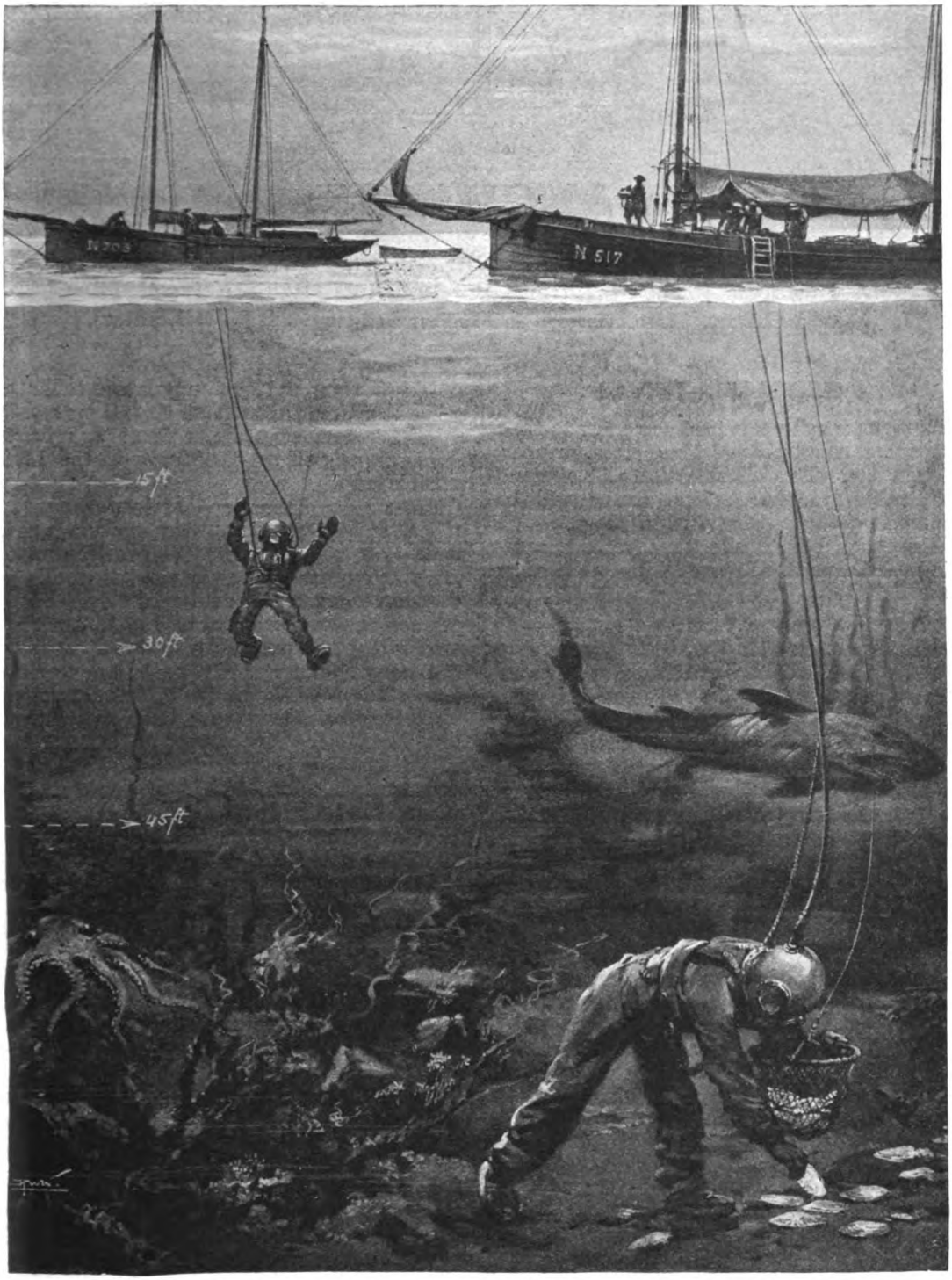
It may not be out of place here to mention a theory of great interest, but not generally known, regarding the origin of these valued adornments.

A Useful Parasite

This interesting theory ascribes the existence of the commercial pearl to the action of a parasitical larva. It is supposed that the embryo worm finds its way into the tissues of the Mollusc, and in certain circumstances produces an abnormal growth of pearl secreting cells with the result that a pearl is formed about the parasite itself.

The occurrence of pearls of any value is very rare. When the pearls are discovered the profit is considerable, but as a set-off against this fact it is a common occurrence for the divers to examine many thousands of shells without finding one that is perfect. Important pearl fisheries other than those of Ceylon are conducted in the Persian Gulf, on the West coast of Central America, and off the North-Western coast of Australia.

A. B.



SCIENTIFIC PEARLING OFF THE NORTH WESTERN COAST OF AUSTRALIA.

When pearls are discovered the profit is great, but divers examine many thousands of shells in order to discover one that is perfect. The arrows above indicate the stages at which a diver's ascent is checked to enable him, by vigorous movement of the limbs, to drive some of the excess nitrogen from his body.

Continued from Vol. IV., page 480.

LANGUAGES:

Contributors **:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.), GERMAN (M. A. Lewenz, M.A. [Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).**

GERMAN.—XXVIII

Adverbs may be classified according to their meaning, as adverbs of time, place, manner, cause, etc. This classification will offer no difficulties to the student, as he will be familiar with it in his own language.

We shall here deal with adverbs according to the parts of speech from which they are derived.

Adverbs formed from Adjectives.—In an earlier lesson it has been stated that almost all adjectives can be used as adverbs. The chief exceptions are: The articles; the pronominal and numeral adjectives (excepting erſt); nearly all participles, except such as have assumed a purely adjectival character; and a few adjectives, such as lieb, wahr, from which adverbs are formed by means of terminations.

The student has also learnt that the comparative and, more rarely, the superlative degree of such adjectives can be used adverbially.

The following are the commonest simple superlatives which can be used adverbially: äußerſt, freundlichſt, gefälligſt, gütigſt, herzlichſt, höchſt, innigſt, jüngſt, längſt, meiſt, möglichſt. They have largely lost their superlative meaning, as the following will show: äußerſt warm, *extremely warm;* er läßt freundlichſt herzlichſt, innigſt grüßen, *he greets in a friendly way, heartily, cordially*, or, as we should say, he sends most friendly, hearty, cordial greetings; ſagen Sie mir gefälligſt, gütigſt, *tell me kindly*, or be so good as to tell me; höchſt modern, *highly fashionable;* jüngſt geſtorben, *recently dead;* längſt vergeſſen, *forgotten a long time ago;* das meiſt geleſene Buch, *the book that is most read;* möglichſt ſchnell, *as quickly as possible.*

Instead of using the simple superlative form of the adjective, it is more general to use a phrase compounded of the prepositions an or auf followed by the definite article (neuter) and the superlative. Thus, das gefiel mir am meiſten, *that pleased me most*: er ſetzt das Haus aufs beſte in Stand, *he repairs the house as well as possible*, or in the best possible way.

There is a distinction between the uses of an and auf; the former is used when there is a real or implied comparison with other things, the latter is used to indicate a general degree of eminence. In a few phrases the prepositions in and zu are also used with the superlative.

A certain number of adverbs are formed from other words by means of terminations:

lich may be added to adjectives, nouns, and participles. The words so formed are adjectives, but some of them are used exclusively in an adverbial sense; the others can, like ordinary adjectives, be used as adverbs too. Examples of those which are only used as adverbs are—freilich, *to be sure*, wahrlich, *truly*, ſchwerlich, *scarcely*, neulich, *recently*, and so on.

lings added to a few adjectives and nouns forms adverbs. Thus, blindlings, *blindly*.

ens added to superlatives and ordinal numerals forms adverbs. Thus, erſtens, *firstly*, höchſtens, *at most* (highest), drittens, *thirdly*. A similar formation is übrigens, *besides, moreover*, from übrig, *left over, remaining.*

s added to a small number of adjectives and participles also forms adverbs. Thus, rechts, *on the right*, links, *on the left*, eilends, *hurriedly.*

The s of the last two terminations is really the sign of the genitive. We have already noted that nouns can be used adverbially in the genitive. Thus, Abends, *of an evening*, Anfangs, *at the beginning*. The student should make a special note of Nachts, *by night*, which, though formed from a feminine noun, takes the masculine genitive termination, by analogy with the examples quoted above and similar formations.

When lich is added to monosyllables, the vowel of the stem is usually modified. Thus, gänzlich, from ganz, *whole;* höflich, *polite*, from Hof, *court*.

The d of Present Participles is mostly changed to t when lich is added. Thus, hoffentlich, *as is to be hoped*, from hoffend, *hoping*. Whereas nouns ending in end retain the d before lich. Thus, jugendlich, *youthful*.

One or two words which end in en insert a t before the lich. Thus, öffentlich, *public*, from offen, *open;* wöchentlich, *weekly*, from Woche, *week*. The student should note that these modify, although they are not monosyllables.

wärts may be added to simple adverbs and nouns to indicate direction. Thus, südwärts, *southward*, aufwärts, *upward*.

Combinations of nouns in oblique cases and limiting words have become adverbs. Thus, jedenfalls, *certainly, under any circumstances*, meiſtenteils, *mostly*, jederzeit, *at any time*, einmal, *once*, vielmals, *often*, ſchlechterdings, *positively*.

Prepositions compounded with a following or preceding noun or with a following adjective form adverbs. Thus, bergauf, *up hill*, überhaupt, *in general*, zuerſt, *at first*, (and with pronouns), indeſſen, *meanwhile, however*, unterdeſſen, *meanwhile*.

Many adverbs are formed by combination of two adverbs or an adverb and a preposition. Thus, hierher, *hither*, dorthin, *thither*, dazwiſchen, *between*, voran, *in front*.

VOCABULARY

The extract to which this vocabulary refers was written towards the end of the eighteenth century, and the older spelling has been retained. This differs little from modern spelling except that the Present Conjunctive of ſein is written ſey instead of ſei, and that all syllables beginning with a t and containing a long vowel insert an h (which does not affect the pronunciation) after the t. Thus, theilen for teilen; and similarly long syllables ending in a t add an h after the t. Thus, werth for wert.

weiſe, *wise*.
Oſten, s.m., *East*.
unſchätzbar, *priceless*.
beſitzen, s., *to possess*.
Farbe, w.f., *colour*.
angenehm, *beloved, pleasant*.
tragen, s., *to wear*.
Verfügung (w.f.), treffen, (s.), *to make an arrangement, order*.
nämlich, *namely*.
feſt ſetzen, w., *to decree*.
ſtets, *always*.
Geburt, w.f., *birth*.
kommen auf, *to come down to*.
Ring, s.m.2, *ring*.
Werth, s.m.2, *worth, value*.
Opal, s.m.2, *opal*.
geheim, *secret*.
Zuverſicht, w.f., *belief, trust, confidence*.
Wunder, s.n.1, *wonder*.
auf ewig, *for ever, eternally*.
erhalten, s., *to keep, maintain*.
wiederum, *in turn*.
Anſehn, s.n.1, *consideration, respect*.
in Kraft, *by virtue*.
verſtehen, s., *to understand*.
gehorſam, *obedient, dutiful*.
ſich entbrechen, s., *to refrain* (from).
würdig, *worthy*.
in Verlegenheit (w.f.), kommen (s.), *get into difficulties*.
kränken, w., *to grieve, hurt*.
Künſtler, s.m.1, *artist*.
beſtellen (w.) bei, *to order from*.
gleich (adj. gov. dat.), *like*.
ſparen, w., *to spare*.
gelingen (impers. gov. dat.), *to succeed*.
froh, *glad*.
insbeſondere, *separately*.
gleich, *equally*.
folglich, *consequently*.
ergießen, s., *to overflow*.
theilen, w., *to share in*.
fromm, *innocent*.
ſchmerzen, w., *to pain*.
ſich verlaſſen (s.) auf, *to rely on*.
in geheim, *secretly*.
Muſter, s.n.1, *pattern*.
Koſten, w.f. pl., *expense*.
vollkommen, *perfectly, exactly*.
heißen, s., *to order*.
unterſcheiden, s., *to distinguish*.
freudig, *happy*.
Segen, s.m.1, *blessing*.

Exercise 63

The following extract from Lessing's play, "Nathan der Weise," requires a few words by way of introduction. Three of the principal characters are Nathan, a wise old Jew, Saladin, the Sultan, and a Knight Templar. The scene is laid in Palestine at the time of the Crusades. Saladin is troubled by the differences to which the three religions, Christianity, Mohammedanism, and Judaism, give rise; he therefore sends for Nathan as the wisest man he knows, and asks him to tell him which of the three is the best religion. Nathan begs leave, before giving the Sultan an answer, to tell a story, and the Sultan consents to listen. Our extract begins with the commencement of the Jew's story. The play is written in blank verse, iambic pentameters.

Nathan.—

Vor grauen Jahren lebt[1] ein Mann im Oſten,
Der einen Ring von unſchätzbarem Werth
Aus lieber[2] Hand beſaß. Der Stein war ein
Opal, der hundert ſchöne Farben[3] ſpielte,
Und hatte die geheime Kraft, vor Gott
Und Menſchen angenehm zu machen, wer'
In dieſer Zuverſicht ihn trug. Was Wunder,
Daß ihn der Mann im Oſten darum nie
Vom Finger ließ[5], und die Verfügung traf,
Auf ewig ihn bei ſeinem Hauſe zu
Erhalten? Nämlich ſo. Er ließ[6] den Ring
Von ſeinen Söhnen dem Geliebteſten[7];
Und ſetzte feſt daß dieſer wiederum
Den Ring von ſeinen Söhnen dem vermache[8],
Der ihm der Liebſte ſey[9], und ſtets der Liebſte,
Ohn' Anſehn der Geburt, in Kraft allein
Des Rings, das Haupt, der Fürſt des Hauſes werde[8].—
Verſteh' mich, Su[4] an.

Saladin.—

Ich verſteh' dich. Weiter.[9]

Nathan.—

So kam nun dieſer Ring, von Sohn zu Sohn,
Auf einen Vater endlich von drei Söhnen,
Die alle drei ihm gleich gehorſam waren,
Die alle drei er folglich gleich zu lieben
Sich nicht entbrechen konnte. Nur von Zeit
Zu Zeit ſchien ihm bald[10] der, bald dieſer, bald
Der dritte, — ſo[11] wie jeder ſich mit ihm
Allein befand, und ſein ergießend Herz
Die andern zwei nicht theilten. — würdiger
Des Ringes[12], den er denn auch einem jeden[13]
Die fromme Schwachheit hatte, zu verſprechen.
Das ging[14] nun ſo, ſo lang' es ging. — Allein
Es kam zum Sterben,[15] und der gute Vater

Kommt[16] in Verlegenheit. Es ſchmerzt ihn, zwei
Von ſeinen Söhnen, die ſich auf ſein Wort
Verlaſſen, ſo zu kränken. — Was zu thun[17]? —
Er ſendet in geheim zu einem Künſtler,
Bei dem er, nach dem Muſter ſeines Ringes,
Zwei andere beſtellt, und weder Koſten
Noch Mühe ſparen[18] heißt, ſie jenem gleich,
Vollkommen gleich zu machen. Das gelingt
Dem Künſtler. Da[19] er ihm die Ringe bringt,
Kann ſelbſt der Vater ſeinen Muſterring
Nicht unterſcheiden. Froh und freudig ruft
Er ſeine Söhne, jeden insbeſondre;
Giebt jedem insbeſondre ſeinen Segen, —
Und ſeinen Ring—und ſtirbt.—Du[20] hörſt doch, Sultan?

NOTES :—

(1) lebt', the e of lebt is elided on account of the metre. (2) lieber Hand, the epithet lieb is transferred from the person to the person's hand. (3) Farben ſpielen, an expression coined on analogy with the noun Farbenſpiel, play of colours, brilliancy. (4) wer . . . trug, a noun clause object of machen. (5) ließ, let (it) leave. (6) ließ, left to. (7) von . . . Geliebteſtem, a departure from the usual order on account of the metre. (8) vermache, ſey, werde, Conjunctives of indirect statement. (9) weiter, go on. (10) bald . . . bald . . . bald, now . . . now . . . now, or first . . . then . . . and then. (11) ſo wie . . . befand, as each happened to be alone with him. (12) des Ringes, genitive dependent on würdig. (13) einem jeden, the reverse of the English order, each one. (14) das . . . ging, that was all very well as long as it lasted; es geht is used idiomatically in the sense of to do all right, to go well. (15) es . . . Sterben, the time came for him to die. (16) kommt, graphic Present. (17) was zu tun? like the French que faire? what is to be done? (18) ſparen, active Infinitive in Passive sense. (19) da, when. (20) du . . , doch, do you really hear, i.e. are you listening?

VOCABULARY

to lead, veranlaſſen, s.
persuade, überreden, w., insep.
instead of, anſtatt, gov. dat.
take up, aufheben, s. (sep.)
considerably, bedeutend.
usual, gewöhnlich.
in safety, unverſehrt.
escape, entwiſchen, w.
into, nach.
France, Frankreich.
plan, conceive the idea, einen ausdenken, w. sep.
deposit oneself, ſich legen, s.
remove, hinaustragen, s. sep.
feel, finden, s.
heavy, ſchwer.
jestingly, im Scherz, s.m.2.
captive, Gefangene, w.m.
frontier, Grenze, w.f.
rejoin, ſich anſchließen, s. sep. gov. dat.

Exercise 64 (*Continued from Exercise* 62)

This[1] led Grotius' wife to conceive the idea of releasing[2] him; and she persuaded him one day[3] to deposit himself in the chest instead of the outgoing[4] books. When the two soldiers appointed[5] to remove it took it up, they felt it to be[6] considerably heavier than usual, and one of them asked jestingly, "Have[7] we got the Arminian himself here?" to which[8] the ready-witted[9] wife replied, "Yes, perhaps some Arminian books." The chest reached Gorcum in safety; the captive was released; and Grotius escaped across the frontier into Brabant, and afterwards into France, where he was joined[10] by his wife.

S. Smiles.

NOTES :—

(1) *This*, say *this circumstance* (Umſtand, s.m.2). (2) *Of releasing him*, say *for his release* (Befreiung, w.f.). (3) *One day*, use the adverbial genitive. (4) *Outgoing*, say *the books which were to be carried out* (hinaustragen). (5) *Appointed*, say *whose duty* (Pflicht, w.f.) *it was*. (6) *To be*, say *that it was*. (7) *Have . . . here*, ſollten wir den Arminius ſelbſt hier in der Kiſte haben? (8) *To which*, worauf. (9) *Ready-witted*, say *with presence of mind*, mit Geiſtesgegenwart. (10) *He was joined*, as ſich anſchließen governs the dative, it cannot be used in the passive. Turn the sentence thus: his wife joined him.

Key to Exercise 61

Already the new mown meadow grass was fading in the midday sun, when Anton shook hands with the neighbour who had taken him as far as the last station before the capital (chief town), and then proceeded vigorously along the high road. It was a smiling summer's day, in the meadows the reaper's scythe rattled against the whetstone, and aloft in the air the untiring lark sang. In front of the traveller (wanderer) the landscape swept onwards in a flat plain, on the horizon behind him rose the blue line of the mountain-chain. Little brooks, edged with groups of alder and willow, flowed merrily through the landscape, each brook formed a valley with meadows, which was bounded on either side by luxuriant cornfields. On all sides the church steeples with their clear bells (the clear bell-steeples of the churches) rose from the earth, each one the centre of a group of brown and red roofs, which was surrounded by a circle of trees. Near many villages, by the stately avenue of trees and the roof of a large building, you could recognise the manor house which lay beside the villages, like a sheep dog next the woolly flock.

NOTE.—In order to make good English of the first sentence it would be necessary to turn it something like this: Already the new mown grass was fading in the midday sun when Anton, after shaking hands with the neighbour who had taken him as far as the last station before the capital, proceeded vigorously, etc.

Key to Exercise 62

Der merkwürdigſte Fall von der Befreiung eines Gatten durch die Aufopferung ſeiner Frau iſt der des berühmten Grotius. Er hatte beinahe zwanzig Monate in der ſtarken Feſtung Loewenſtein bei Gorcum gelegen, da er von der Regierung der Vereinigten Provinzen zu lebenslänglichem Gefängniß verurteilt worden war. Seine Frau durfte ſeine Zelle teilen und erleichterte ihm in großem Maße die Einſamkeit. Es wurde ihr erlaubt zweimal die Woche in die Stadt zu gehen um ihrem Manne Bücher zu bringen, von denen er eine große Anzahl brauchte um ſeine Studien weiterzuführen. Endlich war eine große Kiſte nötig um dieſelben unterzubringen. Die Wache unterſuchte dieſe zuerſt mit großer Strenge; aber als ſie fanden daß ſie nur Bücher, (unter anderen arminiſche Bücher) und Leinen enthielt unterließen ſie ſchließlich die Nachforſchung, und man hielt es für ſelbſtverſtändlich dieſelbe ein und ausgehen zu laſſen.

M. A. L.

RUSSIAN.—XVIII

Russian Commercial Correspondence.

Ру́сская Комме́рческая Корреспонде́нція.

Note.—In dealing with this special section, the student is recommended to adopt the following *modus operandi:* first read out the Russian letter and translate it into English verbally, then copy it out one or more times, and after that make up his own letter by introducing some modifications in the original. As most of the forthcoming terms have already been supplied in the previous lessons, it is hoped that the student will encounter no difficulties in following the suggested programme. If the student has compiled his dictionary, as he was advised at the beginning of this course, it will now prove particularly useful. None the less, notes will be supplied beneath each Russian letter, whenever an explanation of a term is found necessary.

Circular (Циркуля́ръ).

Ма́нчестеръ, Января́ 3-го дня, 1913г.

P.P.—(= præmissis præmittendis = preliminaries omitted.)

Instead of these Latin initials some use the Russian letters: М. Г. = Милости́вые Государи́.

Симъ честь имѣемъ довести́ до Ва́шего свѣдѣ́нія, что мы откры́ли въ э́томъ го́родѣ съ 1-го числа́ сего́ мѣсяца ЭКСПО́РТНУЮ КОНТО́РУ подъ фи́рмой СТА́НЛИ и ДЖЕ́ФФЕРСОНЪ.

Предме́томъ на́шего предпрія́тія бу́детъ преиму́щественно вы́возъ за грани́цу издѣ́лій и проду́ктовъ на́шего кра́я. Въ програ́мму на́шей дѣ́ятельности вхо́дитъ та́кже ввозъ заграни́чныхъ произведе́ній.

На́ше общи́рное знако́мство съ здѣ́шнимъ ры́нкомъ въ связи́ съ соразмѣ́рнымъ на́шему предпрія́тію капита́ломъ ста́вятъ насъ въ вы́годное положе́ніе предоставля́ть на́шимъ г.г. кліе́нтамъ о́чень ва́жныя льго́ты, въ си́лу кои́хъ надѣ́емся заслужи́ть ихъ по́лнаго предпочита́нія насъ други́мъ фи́рмамъ.

Въ заключе́ніе про́симъ Васъ обрати́ть Ва́ше благоскло́нное внима́ніе на на́ши по́дписи, ни́же у сего́, и въ ожида́ніи Ва́шихъ извѣ́стій пребыва́емъ,

Съ соверше́ннымъ почте́ніемъ,
Ста́нли и Дже́ффферсонъ.

Notes:

Довести́ до Ва́шего свѣдѣ́нія; Васъ извѣсти́ть, увѣдоми́ть = to inform you. Предме́томъ, зада́чей, цѣ́лью (Instr. case) = the object. Преиму́щественно, гла́внымъ о́бразомъ = mainly. Издѣ́лій и проду́ктовъ; фабрика́товъ и произведе́ній: manufactures and produce. Край: country district, region. Дѣ́ятельность: activity. Вхо́дить: enters, comes in, goes in. Обши́рное знако́мство: wide acquaintance. Здѣ́шній рынокъ: local market. Въ связи́, совоку́пно: in combination. Соразмѣ́рный: proportionate. Ста́вятъ насъ въ вы́годное положе́ніе: put us in the fortunate (favourable, advantageous) position; enable us. Предоста́вить, предоставля́ть: to grant. Г. = господи́нъ. г.г. = господа́, господ́ъ, господа́мъ, etc. Льго́ты: privileges. Въ си́лу кои́хъ, на основа́ніи кои́хъ: on the strength, basis of which. Заслужи́ть, удосто́иться: to deserve, be worthy. Предпочита́ніе: preferring. Въ заключе́ніе: in conclusion. Обрати́ть благоскло́нное внима́ніе; соблагово́лить замѣ́тить себѣ́: to note kindly. По́дпись: signature. Ни́же у сего́: at foot. И въ ожида́ніи: and in anticipation. Пребыва́емъ, остаёмся: we remain, are. Съ соверше́ннымъ почте́ніемъ; съ и́стиннымъ уваже́ніемъ: respectfully, etc.

Offer of Goods.

Предложе́ніе това́ра.

Ма́нчестеръ. 3-го Января́ 1913 го́да.

Господи́ну
М. Долгору́кову,
въ Москвѣ́
Гости́ный Дворъ, №.....

Милости́вый Госуда́рь!

Отдѣ́льнымъ конвёртомъ мы вы́слали Вамъ сего́дня ма́ленькую колле́кцію образцо́въ то́лько что появи́вшихся въ прода́жѣ но́выхъ сорто́въ ба́рхатовъ. Изъ прило́женнаго при сёмъ прейскура́нта соблагово́лите усмотрѣ́ть всѣ́ могу́щія интересова́ть Васъ подро́бности и цѣ́ны.

Хотя́ на́ши цѣ́ны въ сравне́ніи съ высо́кой доброка́чественностью на́шего това́ра явля́ются са́мыми умѣ́ренныѣ́шими въ ры́нкѣ, мы въ цѣ́ляхъ быстрѣ́йшаго заинтересова́нія Васъ на́шей фи́рмой гото́вы удовлетвори́ться са́мой скромнѣ́йшей при́былью и **предлага́емъ Вамъ при одновре́менномъ зака́зѣ не менѣе двадцати́ ты́сячъ куско́въ де́сять проце́нтовъ** (10%) **ски́дки съ цѣнъ на́шего прейскура́нта плюсъ пять проце́нтовъ за нали́чный разсчётъ.**

Счита́емъ необходи́мымъ заяви́ть, что, е́сли не удосто́имся Ва́шего зака́за до исхо́да сего́ мѣсяца, на́ше предложе́ніе для насъ бо́лѣе не бу́детъ обяза́тельнымъ.

Жела́я Вамъ всего́ хоро́шаго пребыва́емъ
Съ соверше́ннымъ почте́ніемъ.
Ста́нли и Дже́ффферсонъ.

Notes:

Милости́вый Госуда́рь: Dear Sir. То́лько что появи́вшихся въ прода́жѣ: which have just come out in the market. Усмотрѣ́ть: see, learn, gather. Хотя́: although. Въ сравне́ніи: when compared. Явля́ются: are, prove to be. Умѣ́ренный: moderate. Въ цѣ́ляхъ: for the sake, with the aim, view, object, purpose. Гото́вы: prepared. Удовлетвори́ться: to satisfy, limit ourselves. Скро́мный: modest, very small. Одновре́менный зака́зъ: by ordering at one time. Не ме́нѣе: not less. Заяви́ть: to declare, point out. Исхо́дъ мѣсяца: the issue, end of the month, Обяза́тельнымъ: binding. Жела́я Вамъ всего́ хоро́шаго: with best wishes.

Exercise 30

Note.—The student will find all the material for these exercises in the corresponding Reading Exercise and Vocabulary in each lesson.

1. Купе́цъ отказа́лся отъ свое́й до́лжности управля́ющаго два́дцать пѣ́ть тому́ наза́дъ.
2. Мы откры́ли дѣ́ло сообща́ со ста́рымъ дру́гомъ.
3. Мы пріобрѣ́ли хоро́шее зна́ніе дѣ́ла.
4. Здѣ́сь исто́чникъ това́ровъ.
5. Производ́ствомъ хлопча́то-бума́жныхъ издѣ́лій занима́ются въ ра́зныхъ города́хъ Ла́нкашира.
6. Что составля́етъ гла́вную промы́шленность э́той ча́сти страны́?
7. На́ши кліе́нты произво́дятъ торго́влю маши́нами въ широ́кихъ разма́рахъ.

8. Когда́ това́ры получа́ются, упако́вка вскрыва́ется.

9. На́ша о́пытность есте́ственно привела́ насъ въ соприкосновéніе съ гла́вными фи́рмами въ ри́нкѣ.

10. Многія ли́ца заинтересо́ваны въ произво́дствѣ, прода́жѣ и употребле́нiи упомя́нутыхъ предме́товъ.

11. Вы должны́ быть снабже́ны необходи́мыми позна́ніями, да́бы быть въ состоя́нiи успѣ́шно выполня́ть тре́бованiя, Ва́шихъ покупа́телей.

12. Мы должны́ удержа́ть для себя́ соразмѣ́рное вознагражде́ніе за нашъ трудъ и расхо́дъ.

13. Не забыва́йте обезпе́чивать себя́ отъ ри́ска, кото́рому Вы себя́ подверга́ете при сноше́нiяхъ съ отдале́нными мѣ́стностями.

14. Э́то обстоя́тельство значи́тельно затрудня́етъ улаживанiе недоразумѣ́нiй.

15. Ну, переду́мали ли Вы о́бо всѣхъ э́тихъ обстоя́тельствахъ?

16. Е́сли Вы не имѣ́ете доста́точно капита́лу, я гото́въ одолжи́ть Вамъ нѣ́которую су́мму.

17. Переговори́те объ э́томъ дѣ́лѣ съ Ва́шимъ дру́гомъ и сообщи́те мнѣ оконча́тельный результа́тъ.

18. Жела́ли бы Вы прiобщи́ться ко мнѣ въ подо́бномъ предпрiя́тiи?

19. Онъ ча́сто гова́ривалъ мнѣ о его́ жела́нiи откры́ть кой-како́е дѣ́ло въ това́риществѣ со мно́ю.

20. Располага́ете ли Вы доста́точными сре́дствами для оправда́нiя всѣхъ обяза́тельствъ, кото́рыхъ Вамъ немину́емо приде́тся брать на себя́?

Exercise 31

NOTE.—The student will find all the material for these exercises in the corresponding Reading Exercise and Vocabulary in each lesson.

1. Do you think there will be any trouble to anticipate on the financial side?
2. All the partners very soon came to an understanding.
3. Will you kindly draw up a memorandum of all details of the proposed agreement?
4. When did you take this memorandum over to your lawyer?
5. The lawyer put it into legal shape as a Deed of Partnership.
6. What will be your next move after finding suitable premises?
7. If we had a small staff of assistants, they could attend to the preliminary details.
8. These details (preliminary labours) consist mainly in advising prospective customers of our having established ourselves in Manchester as shipping merchants.
9. In the circulars containing these particulars, you might set forth all the advantages we hope the customers will enjoy by dealing with us.
10. Through our capital and experience, we hope to enjoy many advantages.
11. Many of our clients are informed of these advantages through their personal acquaintance with ourselves.
12. We hope to make your personal acquaintance when you next (next time) come to England.
13. Whilst traveller and subsequently manager for my old firm, I acquired much useful experience.
14. Together with the letters announcing these facts, you should send some nice patterns.
15. In these letters we shall state the terms of payment and enclose price-lists of the patterns submitted.
16. I shall also show discounts, if any, and all other details to enable the customer to make up his mind as to whether it suits him to give us any orders.

A. C.

GREEK.—VI

ADVERBS are formed from adjectives by changing the ν of the genitive plural to ς, as follows:—

Adjective.	*Genitive Plural.*	*Adverb.*
φίλος, *loving*	φίλων	φίλως, *lovingly*
καλός, *beautiful*	καλῶν	καλῶς, *beautifully*
ἁπλοῦς, *simple*	ἁπλῶν	ἁπλῶς, *simply*
πᾶς, *all*	πάντων	πάντως, *altogether*
σώφρων, *wise*	σωφρόνων	σωφρόνως, *wisely*
ταχύς, *swift*	ταχέων	ταχέως, *swiftly*
μέγας, *great*	μεγάλων	μεγάλως, *greatly*
ἀληθής, *true*	ἀληθέων, ἀληθῶν	ἀληθῶς, *truly*
συνήθης, *accustomed*	συνηθῶν	συνήθως, *according to custom*

The local endings -θεν, -θι, and -δε form adverbs of place by being added to nouns and pronouns; -θεν, denoting *whence*, -θι, *where*, and -δε *whither*. For example, οὐρανόθεν, *from heaven*; οὐρανόθι, *in heaven*; οὐρανόνδε, *to heaven*. With pronouns, -δε becomes -σε: thus ἀλλόσε, *to some other place*; so with ἐκεῖ, *there*—as ἐκεῖσε, *thither*. In the plural of the substantives in -ας, -σδε passes into -ξε, as Ἀθήναξε for Ἀθήνασδε (from Ἀθῆναι, -ῶν, the city *Athens*).

Many adverbs of place terminate in ω, as ἄνω, *above*, κάτω, *below*, ἔξω, *without*, ἔσω, *within*. Other adverbs are obviously cases of nouns or pronouns, as the genitives ποῦ, *somewhere*, ὅπου, οὗ, *where*; αὐτοῦ, *on that spot*, οὐδαμοῦ, *nowhere*.

Accusatives also are common, as πρώην, *at dawn*, μακράν, *a long way*, πέραν, *beyond a place*, πολύ or πολλά, *much*, μέγα or μεγάλα, *greatly*, δωρεάν, *gratis*, σήμερον, *to-day*, αὔριον, *to-morrow*.

Comparison of Adverbs

The neuter singular of the comparative adjective is used for the comparative, and the neuter plural for the superlative, of the corresponding adverb: thus:—

	From.	*Comparative.*	*Superlative.*
σοφῶς	(σοφός), *wisely*	σοφώτερον	σοφώτατα
σαφῶς	(σαφής), *clearly*	σαφέστερον	σαφέστατα
χαριέντως	(χαρίεις), *charmingly*	χαριέστερον	χαριέστατα
εὐδαιμόνως	(εὐδαίμων), *happily*	εὐδαιμονέστερον	εὐδαιμονέστατα
αἰσχρῶς	(αἰσχρός), *shamefully*	αἴσχιον	αἴσχιστα
ἡδέως	(ἡδύς), *pleasantly*	ἥδιον	ἥδιστα
ταχέως	(ταχύς), *swiftly*	(θᾶττον) θᾶσσον	τάχιστα

Adverbs of place in ω retain that termination in the comparative and superlative:—

	Comparative.	*Superlative.*
ἄνω, *above.*	ἀνω-τέρω	ἀνω-τάτω
κάτω, *below.*	κατω-τέρω	κατω-τάτω

So comparatives and superlatives in ρω are formed:—

	Comparative.	*Superlative.*
πέρα, *beyond.*	περαιτέρω	(*none*)
τηλοῦ, *at a distance.*	τηλοτέρω	τηλοτάτω
ἐγγύς, *near.*	ἐγγυτέρω	ἐγγυτάτω

The following are irregular and should be compared with § 64 :—

εὖ, *well*	ἄμεινον, *better*	ὄριστα, *best*
μάλα, *much, very*	μᾶλλον, *more, rather*	μάλιστα, *most, especially*
πολύ, *much*	πλέον, *more*	πλεῖστον or πλεῖστα, *most*
ὀλίγον, μικρόν, *little*	ἔλασσον, ἧσσον, μεῖον, *less*	ἐλάχιστα, ἥκιστα, *least*

The Numerals

The following table gives in order the English and Greek signs, the cardinal and ordinal numerals, and the corresponding adverbs :—

1	α′	εἷς μία ἕν, *one*	πρῶτος, *first*	ἅπαξ, *once*
2	β′	δύο, or δύω, *two*	δεύτερος, *second*	δίς, *twice.*
3	γ′	τρεῖς, τρία, *three*	τρίτος, *third*	τρίς, *thrice*
4	δ′	τέσσαρες, τέσσαρα, *four*	τέταρτος, *fourth*	τετράκις
5	ε′	πέντε, *five*	πέμπτος	πεντάκις
6	ϛ′	ἕξ, *six*	ἕκτος	ἑξάκις
7	ζ′	ἑπτά	ἕβδομος	ἑπτάκις
8	η′	ὀκτώ	ὄγδοος	ὀκτάκις
9	θ′	ἐννέα	ἔνατος	ἐνάκις
10	ι′	δέκα	δέκατος	δεκάκις
11	ια′	ἕνδεκα	ἑνδέκατος	ἑνδεκάκις
12	ιβ′	δώδεκα	δωδέκατος	δωδεκάκις
13	ιγ′	τρισκαίδεκα or τρεῖς (τρία) καὶ δέκα	τρισκαιδέκατος or τρίτος καὶ δέκατος	τρισκαιδεκάκις
14	ιδ′	τεσσαρεσκαίδεκα or τέσσαρες (τέσσαρα) καὶ δέκα	τεσσαρακαιδέκατος or τέταρτος καὶ δέκατος	
15	ιε′	πεντεκαίδεκα	πεντεκαιδέκατος	
16	ιϛ′	ἑκκαίδεκα	ἑκκαιδέκατος	
17	ιζ′	ἑπτακαίδεκα	ἑπτακαιδέκατος	
18	ιη′	ὀκτωκαίδεκα	ὀκτωκαιδέκατος	
19	ιθ′	ἐννεακαίδεκα	ἐννεακαιδέκατος	
20	κ′	εἴκοσι(ν)	εἰκοστός	εἰκοσάκις
21	κα′	εἷς καὶ εἴκοσι, εἴκοσι καὶ εἷς, or εἰκοσιν εἷς, μία, ἕν	πρῶτος καὶ εἰκοστός	
30	λ′	τριάκοντα	τριᾱκοστός	τριᾱκοντάκις
40	μ′	τεσσαράκοντα	τεσσαρακοστός	
50	ν′	πεντήκοντα	πεντηκοστός	
60	ξ′	ἑξήκοντα	ἑξηκοστός	
70	ο′	ἑβδομήκοντα	ἑβδομηκοστός	
80	π′	ὀγδοήκοντα	ὀγδοηκοστός	
90	ϙ	ἐνενήκοντα	ἐνενηκοστός	ἐνενηκοντάκις
100	ρ′	ἑκατόν	ἑκατοστός	ἑκατοντάκις
200	σ′	διᾱκόσιοι, -αι, -α	διακοσιοστός	διακοσιάκις
300	τ′	τριᾱκόσιοι, -αι, -α	τριακοσιοστός	
400	υ′	τετρᾰκόσιοι, -αι, -α	τετρακοσιοστός	
500	φ′	πεντᾰκόσιοι, -αι, -α	πεντακοσιοστός	
600	χ′	ἑξᾰκόσιοι, -αι, -α	ἑξακοσιοστός	
700	ψ′	ἑπτᾰκόσιοι, -αι, -α	ἑπτακοσιοστός	
800	ω′	ὀκτᾰκόσιοι, -αι, -α	ὀκτακοσιοστός	
900	ϡ	ἐνᾰκόσιοι, -αι, -α	ἐνακοσιοστός	ἐνακοσιάκις
1,000	,α	χίλιοι, -αι, -α	χιλιοστός	χιλιάκις
2,000	,β	δισχίλιοι, -αι, -α	δισχιλιοστός	
3,000	,γ	τρισχίλιοι, -αι, -α	τρισχιλιοστός	
10,000	,ι	μύριοι, -αι, -α	μυριοστός	μυριάκις
20,000	,κ	δισμύριοι or δισμυριάδες, etc.	δισμυριοστός	δισμυριάκις

The four first numerals and the round numbers from διακόσιοι, 200, to μύριοι, 10,000, and its compounds, are the only cardinal numerals that are declined. The ordinals are regularly declined as adjectives of three terminations. In compound numbers, the smaller number may come first, and the larger after with καὶ between, as πέντε καὶ εἴκοσιν, *five and twenty*; or this order may be reversed, and the conjunction either retained or omitted, as εἴκοσι καὶ πέντε, *twenty and five*, or εἴκοσι πέντε, *twenty-five*; and πέντε καὶ τετταράκοντα καὶ τριακόσιοι, or τριακόσιοι καὶ τετταράκοντα καὶ πέντε, or τριακόσιοι τετταράκοντα πέντε, 345. So *twenty-fifth* may be εἰκοστὸς πέμπτος or πέμπτος καὶ εἰκοστός.

Note that μύριοι is *ten thousand*, but μυρίοι, *innumerable*. In the latter sense we find it used in the singular as μυρίον πένθος, *infinite sorrow*, μυρίος χρόνος, *endless time*.

The first four numerals εἷς, *one*, δύο, *two*, τρεῖς, *three*, and τέσσαρες, *four*, are thus declined :—

	M.	*F.*	*N.*	*All Genders.*
Nom.	εἷς	μία	ἕν	δύο
Gen.	ἑνός	μιᾶς	ἑνός	δυοῖν
Dat.	ἑνί	μιᾷ	ἑνί	δυοῖν
Acc.	ἕνα	μίαν	ἕν	δύο

	M.F.	*N.*	*M.F.*	*N.*
Nom.	τρεῖς	τρία	τέσσαρες (or τέτταρες)	τέσσαρα
Gen.	τριῶν		τεσσάρων	
Dat.	τρισί(ν)		τέσσαρσι(ν)	
Acc.	τρεῖς	τρία	τέσσαρας	τέσσαρα

Like εἷς, are declined its compounds, οὐδείς and μηδείς, *no one*; thus οὐδείς, οὐδεμία, οὐδέν; genitive οὐδενός, οὐδεμιᾶς, etc.; plural (rare), οὐδένες, οὐδένων, οὐδέσι, etc.

The numeral ἄμφω, *both*, has genitive and dative, ἀμφοῖν.

Pronouns

Pronouns in Greek may be conveniently classified as Personal, Reflexive, Reciprocal and Possessive.

Personal Pronouns

The personal pronouns are ἐγώ, *I*, σύ, *thou*, and the oblique cases οὗ, *of himself*, etc., of a pronoun having no nominative, and of the adjective pronoun αὐτός. These are declined as follows :—

	Singular.		
Nom.	ἐγώ, *I*	σύ, *thou*	
Gen.	ἐμοῦ, μοῦ, *of me*	σοῦ, *of thee*	οὗ, of *himself, herself, itself*, etc.
Dat.	ἐμοί, μοί, *me*	σοί, *thee*	οἱ, *to himself*
Acc.	ἐμέ, μέ, *me*	σέ, *thee*	ἕ, *himself*

		Plural.	
Nom.	*ἡμεῖς, we*	*ὑμεῖς, ye*	*σφεῖς* [n. *σφέα*], *they*
Gen.	*ἡμῶν, of us*	*ὑμῶν, of you*	*σφῶν, of them*
Dat.	*ἡμῖν, to us*	*ὑμῖν, to you*	*σφίσι(ν), to themselves*
Acc.	*ἡμᾶς, us*	*ὑμᾶς, you*	*σφᾶς* [n. *σφέα*], *themselves*
		Dual.	
N.A.	*νώ, we (us) two*	*σφώ, you two*	
G.D.	*νῷν, of (to) us two*	*σφῷν, of (to) you two*	

Αὐτός, -ή, -ό, in the nominative corresponds to the Latin *ipsĕ, self*, and may have this meaning as an adjective pronoun in the oblique cases.

	Masc.	*Fem.*	*Neut.*
	Singular.		
Nom.	αὐτός	αὐτή	αὐτό
Gen.	αὐτοῦ	αὐτῆς	αὐτοῦ
Dat.	αὐτῷ	αὐτῇ	αὐτῷ
Acc.	αὐτόν	αὐτήν	αὐτό
	Plural.		
Nom.	αὐτοί	αὐταί	αὐτά
Gen.	αὐτῶν	αὐτῶν	αὐτῶν
Dat.	αὐτοῖς	αὐταῖς	αὐτοῖς
Acc.	αὐτούς	αὐτάς	αὐτά
	Dual.		
N.A.	αὐτώ	αὐτώ	αὐτώ
G.D.	αὐτοῖν	αὐτοῖν	αὐτοῖν

The personal pronouns are used in the nominative only when special emphasis is intended, as in marking a contrast.

Preceded by the article αὐτός means *the same*. Thus ὁ αὐτὸς θεός, *the same god*, τὸ αὐτό, *the same thing*. It often contracts with the article thus, ταὐτοῦ (τοῦ αὐτοῦ), ταὐτῷ (τῷ αὐτῷ), ταὐτῇ (τῇ αὐτῇ), ταὐτό or ταὐτόν (τὸ αὐτό); plural, αὐτοί (οἱ αὐτοί), αὐταί (αἱ αὐταί), ταὐτά (τὰ αὐτά); dual, ταὐτώ (τὼ αὐτώ) and ταὐτά (τὰ αὐτά). Be careful not to mistake ταὐτῇ, *to the same*, for ταύτῃ, *to this*, fem. dat. sing. of οὗτος, or ταὐτά, *the same things*, for ταῦτα, *these things*.

Reflexive Pronouns

By the combination of the simple personal pronouns with αὐτός are formed the reflexive pronouns ἐμαυτοῦ, ἐμαυτῆς, *of myself*, σεαυτοῦ, σεαυτῆς, *of thyself*, and ἑαυτοῦ, ἑαυτῆς, *of himself, of herself*, which are declined as follows:—

		Singular.	
Gen.	ἐμαυτοῦ, -ῆς	σεαυτοῦ (σαυτοῦ), -ῆς	ἑαυτοῦ (αὐτοῦ), -ῆς
Dat.	ἐμαυτῷ, -ῇ	σεαυτῷ (σαυτῷ), -ῇ	ἑαυτῷ (αὐτῷ), -ῇ
Acc.	ἐμαυτόν, -ήν	σεαυτόν (σαυτόν), -ήν	ἑαυτόν (αὐτόν), -ήν, -ό
		Plural.	
Gen.	ἡμῶν αὐτῶν	ὑμῶν αὐτῶν	ἑαυτῶν (αὐτῶν), or σφῶν αὐτῶν
Dat.	ἡμῖν αὐτοῖς, -αῖς	ὑμῖν αὐτοῖς, -αῖς	ἑαυτοῖς, -αῖς (αὐτοῖς, -αῖς), or σφίσιν αὐτοῖς, -αῖς
Acc.	ἡμᾶς αὐτούς, -άς	ὑμᾶς αὐτούς, -άς	ἑαυτούς, -άς, -ά (αὐτούς, -άς, -ά), or σφᾶς αὐτούς, -άς, σφέα αὐτά

This combination of the personal pronoun and αὐτός is not found in Homer, where they are kept separate as in σοὶ αὐτῷ, ἕ αὐτήν, etc.

Be careful not to mistake the contracted forms αὑτοῦ, αὑτῆς, etc., for the oblique cases of αὐτός, αὐτοῦ, αὐτῆς, etc.

Reciprocal Pronouns

While the reflexive pronouns denote the throwing back of the action on the subject, the reciprocal pronoun ἀλλήλων, *of one another*, denotes interchange of the action or mutual reaction between two sets of persons. They are used only in the plural and dual, and are declined as follows:—

	Plural.	*Dual.*
Gen.	ἀλλήλων	ἀλλήλοιν, -αιν, -οιν
Dat.	ἀλλήλοις, -αις, -οις	ἀλλήλοιν, -αιν, -οιν
Acc.	ἀλλήλους, -ας, -α	ἀλλήλω, -α, -ω

Possessive Pronouns

The possessive pronouns partake of the nature of an adjective as well as of a pronoun, and are often described as adjective pronouns. They comprise the following, which are declined like adjectives ending in -ος:—

ἐμός, -ή, -όν, *my*	ἡμέτερος, -α, -ον, *our*
σός -ή, όν, *thy*	ὑμέτερος, -α, -ον, *your*
σφέτερος, -α, -ον, *their*	

There is also a poetic form ὅς, *his, her, its*, not used in Attic prose, where it is superseded by the genitive of αὐτός, as in, ἡ θυγάτηρ αὐτοῦ, *his daughter*. The genitive of the personal pronouns ἐγώ, σύ, αὐτοῦ, -ῆς, -οῦ, and that of the reflexive pronoun ἐμαυτοῦ, ῆς, -οῦ, are often used in preference to the possessive pronouns. For example, ὁ ἀδελφὸς αὐτοῦ, *his brother*, τύπτει τὸν ἑαυτοῦ υἱόν, *he strikes his* or *his own son*.

Note that the pronoun must be preceded by the article, as in the sentences just quoted or in ἡ ἐμὴ θυγάτηρ, *my daughter*. The pronoun may also be placed after the substantive, in which case the article must be repeated, as in ἡ θυγάτηρ ἡ ἐμή or τύπτει τὸν υἱὸν τὸν ἑαυτοῦ.

The possessive pronoun is used mainly for the sake of emphasis. When no contrast or other emphasis is intended, the pronoun is omitted and the simple article is found instead, as in ἡ μήτηρ στέργει τὴν θυγατέρα, *the mother loves the* (*her*) *daughter*.

VOCABULARY

ἀκούω, I hear.
βλάπτω, I injure, disable.
βλέπω, I see.
διαφέρω, I differ from (gen.).
εὐφραίνω, I cheer, gladden.
λύρα, ἡ, lyre.
παίζω, I play.
στέργω, I love.
συγχαίρω, I rejoice with (dat.).
τε, and (enclitic).
τοκεύς, -έως, ὁ, father, parent.
φύλαξ, -ακος, ὁ, guard, watcher.

Exercise 6

(*a*) Translate into English:—

1. Νῶ μὲν γράφετον, σφὼ δὲ παίζετον. 2. Ἡμεῖς μὲν γράφομεν, ὑμεῖς δὲ παίζετε. 3. Ἡμῶν ἄκουε, ὦ παῖ. 4. Θεὸς ἀεὶ ὑμᾶς βλέπει. 5. Εἰ ἐγὼ βλάπτω ὑμᾶς, οὐ συγχαίρετε μοί. 6. Σὺ συγχαίρεις ἡμῖν.

(*b*) Translate into Greek:—

1. O boy, listen to me. 2. God always sees thee. 3. I worship thee, O great Zeus. 4. I write, but thou playest. 5. If you hurt me, you are not different from my enemies. 6. I am stronger than you.

Key to Exercise 5

(*a*) 1. There is nothing sweeter than deep sleep. 2. There is nothing more shameful than slavery. 3. Nothing is more unfriendly than ill advice. 4. Evil men think one thing and say another. 5. Nothing is sweeter than a faithful friend. 6. The deepest sleep is the sweetest.

(*b*) 1. Οὐδὲν τῷ ἀνθρώπῳ ἔχθιον ἐστιν ἢ ὁ ἄνθρωπος. 2. Οὐδεὶς νόμος ἰσχύει μεῖζον τῆς ἀνάγκης. 3. Ὁ πόλεμος πλεῖστα κακὰ φέρει. 4. Γυνὴ ἐσθλὴ πλεῖστα ἀγαθὰ τῷ οἴκῳ φέρει. 5. Τὰ ἀναγκαῖα τοῦ βίου φέρε ὡς ῥᾷστα. 6. Τὸ κελεύειν ῥᾳόν ἐστι τοῦ πράσσειν. E. A. B.

ITALIAN.—V

The Pronoun.—As a direct object the pronoun is joined to, or precedes, the verb, and is called **conjunctive.** Following a preposition, the pronoun is called **disjunctive.**

The accusative and dative cases of Conjunctive Pronouns are as follows:—

Accusative = Direct Object	*Dative = Indirect Object*
mi, *me, myself*	mi, *to me, to myself.*
ti, *thee, thyself*	ti, *to thee, to thyself.*
lo, *him, it* (m.)	gli, *to him, to it* (m.).
la, *her, it* (f.)	le, *to her, to it* (f.).
si, *himself, herself, oneself, itself* (m., f.)	si, *to himself, to herself, to oneself, to herself* (m., f.).
ci, *us, ourselves*	ci, *to us, to ourselves.*
vi, *you, yourselves*	vi, *to you, to yourselves.*
li, *them* (m.)	loro, *to them* (m., f.).
le, *them* (f.)	
si, *themselves* (m., f.)	si, *to themselves* (m., f.).

Note that **loro** always follows the verb, and is not joined to it.

The other pronouns follow and are joined to the verb in the infinitive, present participle (gerund), past participle (when used without auxiliary), and *affirmative* imperative (1st and 2nd persons), but in all other instances they precede the verb.

The Verb.—We will now compare the Present Indicative of the verbs of the three conjugations, taking for our examples **comprare, vendere, partire.**

Indicative—Present Tense

FIRST OR **A** CONJUGATION

Terminations

Sing.	*Plur.*
1. -o	1. -iamo
2. -i	2. -ate
3. -a	3. -ano

Sing.	*Plur.*
1. compro, *I buy* *	compriamo, *we buy.*
2. compri, *thou buyest*	comprate, *you buy.*
3. compra, *he buys*	cómprano, *they buy.*

SECOND OR **E** CONJUGATION

Sing.	*Plur.*
1. -o	-iamo
2. -i	-ete
3. -e	-ono

Sing.	*Plur.*
1. vendo, *I sell*	vendiamo, *we sell.*
2. vendi, *thou sellest*	vendete, *you sell.*
3. vende, *he sells*	véndono, *they sell.*

THIRD OR **I** CONJUGATION

Sing.	*Plur.*
1. -o	-iamo
2. -i	-ite
3. -e	-ono

Sing.	*Plur.*
1. parto, *I depart, start*	partiamo, *we depart.*
2. parti, *thou departest*	partite, *you depart.*
3. parte, *he departs*	pártono, *they depart.*

The following are the principal verbs which, with their derivatives, are conjugated like **Partire** †:—

bollire, *to boil.*	pentirsi, *to repent.*
consentire, *to consent.*	seguire, *to follow.*
convertire†, *to convert.*	sentire, *to feel.*
cucire, *to sew.*	servire, *to serve.*
divertire, *to amuse.*	soffrire, *to suffer.*
dormire, *to sleep.*	sortire, *to go out.*‡
fuggire, *to flee.*	tossire, *to cough.*
investire, *to invest.*	vestire, *to dress.*
mentire,† *to lie, tell a lie.*	

VOCABULARY

alto, *high.*	lo scellino, *shilling.*
la notte, *night.*	préndere, *to take.*
male, *ill, bad.*	la libertà, *liberty.*
come, *like, as.*	trasméttere, *to transmit, convey.*
il venditore, *seller.*	la léttera di cambio, la prima di cambio, *bill of exchange.*
ogni, *every, each.*	cinquemila, *five thousand.*
la volta, *time.*	la lira, *lira* (Italian coin).
aprire, *to open.*	pregare, *to wish, request.*
la giornata, *the day, the events of a day.*	quello, *that* (demons. adj. or pronoun).
il ghiro, *dormouse.*	in magazzino, in esistenza, *in stock.*
dimenticare, *to forget.*	ecco, *here is.*
dimenticate, (you) *forget* (imper.).	
la dimenticanza, *forgetfulness.*	

* Also, I am buying, do buy, etc.; do I buy? am I buying? etc. In each person the one word in Italian expresses all these additional meanings.

† These three verbs may also insert **isc** between the stem and the root in certain cases, as will be shown in Lesson VI.

‡ **Uscire** is preferable, as **sortire** is a Gallicism.

il provérbio, *proverb.*
chi, *he who.*
pigliare, *to take, catch.*
il pesce, *fish.*
acconsentire, *to consent.*
la proposta, *proposal.*
giacchè, *since, as.*
póssono, *they can*
agire, *to act.*
altrimenti, *otherwise.*
ne, *from it, thence* (French " en ").
chiaramente, *clearly.*
fuggire, *to flee, fly.*
sfuggire, rifuggire, *to escape.*
la fretta, *haste, hurry, speed.*
affrettarsi, *to make haste.*
il treno, il convóglio, *train.*
otto, *eight.*
mezzo, *half.*
le otto e mezzo, *half-past eight.*
presente, *present.*
partecipare, *to impart, inform.*
stabilire, *to establish.*
la piazza, *place, market.*
non . . . (verb) . . . mai, *never.*
divertirsi, *to enjoy, amuse oneself.*
generalmente, *generally.*
accennare, menzionare, *to mention.*
l'acqua (f.), *water.*
vóglio, *I want.*
bere, *to drink.*
il tè, *tea.*
caldo caldo, *very warm, hot.*
il franco, *franc.*
poi, *then, afterwards.*
poichè, *since, because.*
uscire, *to go out.*
fondi púbblici, *public stocks.*
vero, *true.*
il quale, *which.*
meglio (di), *better* (than).
la sorella, *sister.*
ricordarsi, *to remember.*
v'è, v'ha (= vi ha), c'è, *there is.*
inglese, *English.*
l'estratto (m.), *extract.*
piácciavi, *be so kind as to, be pleased to.*
avvisare, *to advise, inform.*
la memoria, *the memory.*
il velluto, *the velvet.*
il velluto di cotone, *velveteen.*
unito, *enclosed.*
d'accordo, *in agreement.*
provare, *to prove.*
incurábile, *incurable.*
date (you), *give* (imper.).
fate (you), *make* (imper.).
il ragazzo, *boy.*
il padrone, *master.*
deve, *he must.*
dovete, *you must.*
pagare, *to pay.*
la nota, *note.*
allora, *then.*
il dubbio, *doubt.*
il seno, *breast.*
qui in seno, *enclosed herewith.*
débitamente, *duly.*
indossare, girare, *to endorse.*
scusare, *to excuse.*
il di lei, *her.*
favoloso, *fabulous.*
confidare, *to entrust.*
la fidúcia, *confidence.*
l'intenzione (f.), *intention.*
il filato di lana, *woollen yarn.*
consultare, *to consult.*
il médico, *doctor.*
cominciare, principiare, *to begin.*
più presto, *earlier.*
in lúi, *in him.*
tanto, *such, so much.*
la malattía, *illness.*
sino a tarda ora, *until late.*
schivare, *to shun, avoid.*
così, *thus.*
amare, *to love, like.*
trecento, *three hundred.*
rinviare, *to send back, return.*
di nuovo, *again.*
lo scansafatiche, *idler.*
vede (he), *sees.*

Exercise 9

Translate into English :—

1. Dice che tosse tutta la notte e che adesso si sente molto male. 2. Mi rincresce dirvi, come l'ho (= lo ho) detto a loro (or, come ho detto loro), che il venditore mente ogni volta che apre la bocca. 3. Dopo una giornata di fatica dormo come un ghiro. 4. Non dovete dimenticare il provérbio : " Chi dorme non píglia pesci." 5. Acconséntono alla nostra proposta, giacchè non póssono agire altrimenti. 6. Ne segue chiaramente che si péntono di éssere fuggiti dai creditori. 7. Si veste sempre in fretta e parte col treno (convóglio) delle otto e mezzo. 8. La presente (léttera) serve a parteciparvi (or, Con la presente vi informiamo) che ci siamo stabiliti in questa piazza. 9. Mi duóle di dovervi dire che non mi diverto mai dal Signor (before a name, instead of (*Signore*) Rossi.

Exercise 10

Translate into Italian :—

1. We entrust to them the purchase of all our goods in their market. 2. I am glad to (di) know that you have the intention of making (to make) me a remittance soon. 3. We have succeeded in (omit) disposing of (infin.) all the sending of woollen yarn at good prices. 4. If he coughs so much (tanto) and feels (reflexive = feels himself) so bad, why does he not consult a doctor ? A. C.

SPANISH.—V

The Adjective.—Adjectives agree in gender and number with the noun, **-o** masculine becomes **-a** feminine and **-s** is added for the plural.

Adjectives ending in **n** or **or** usually add **a** for feminine, as : **un negòcio exportadòr,** *an exporting business ;* **ùna càsa exportadòra,** *an exporting house* (*firm*). Those indicating nationality, ending in a consonant, add **a,** as : **inglés,** *English.* **inglèsa** (f.) ; **español,** *Spanish,* **española** (f.).

Examples

El envío pequèño,	*The small sending* (shipment of goods).
Los envíos pequèños,	*The small sendings* (shipments of goods).
La muèstra pequèña,	*The small pattern.*
Las muèstras pequèñas,	*The small patterns.*

There is a neuter article : **lo,** *the,* used only in the singular with adjectives and other parts of speech, meaning : **lo que es,** *that which is,* as :

Lo buèno, *the good* (that which is good).	Lo pasàdo, *the past* (that which is past).

The Pronoun.—Conjunctive Pronouns are affixed to verbs when the latter are in the Infinitive, Gerund (Present Participle), or Imperative Affirmative, as :

DATIVE (= *to*)

	Sing.	*Plur.*
1.	decìrme, *to say to me.*	decìrnos, *to say to us.*
2.	decìrte (fam.), *to say to thee.*	decìros (fam.), *to say to you* (fam.).
3.	decìrle, *to say to him, to her, to it, to you* (polite).	decìrles, *to say to them, you* (polite).

ACCUSATIVE (direct object)

	Sing.	*Plur.*
1.	vèrme, *to see me.*	vèrnos, *to see us.*
2.	vèrte (fam.), *to see thee.*	vèros, *to see you* (fam.).
3.	vèrlo, -la, -le, *to see it, her, him,* or *you.*	vèrlos, -las, -les, *to see them* (m. and f.), *you* (polite).

DATIVE AND ACCUSATIVE

	Sing.	*Plur.*
1.	dármelo (m.) (f. -la, m. -los, f. -las), *to give it (them) to me*, or literally, *to give to me it* (them).	dárnoslo (m.) (f. -la, m. -los, f. -las), *to give it (them) to us.*
2.	dártelo (m.) (fam.) (f. -la, m. -los, f. las), *to give it (them), to thee.*	dároslo (m.) (fam.) (f. -la, m. -los, f. las), *to give it (them) to you* (fam.).
3.	dárselo (m.) (f. -la, m. -los, f. -las), *to give it (them) to him, to her, to you* (polite).	dárselo (m.) (f. -la, m. -los, f. -las), *to give it (them) to them, you* (polite).

It will be noticed that **se** in **dárselo** is used for the sake of euphony, instead of **le** or **les**, as **dárlelo** or **dárleslo**, etc., are never used.

N.B.—As shown above, a dative pronoun always precedes an accusative pronoun.

Conjunctive pronouns precede the verb in other instances, though for literary effect, they sometimes follow the verb in the Present, Imperfect and Past Definite Indicatives, if the latter begin the sentence, as :

Le dàmos á V. la càrta, (where both **le** and **V.** are used for clearness and emphasis).	*We give the letter to you*
Me escribe (escríbeme, literary form) que vendrá mañàna,	*He writes me that he will come to-morrow.*
Se las doy las càrtas á Vs.	*I give you the letters.*
Se las doy (las càrtas) á Vs.	*I give them to you.*
Me dàba (dábame, literary form) mùchos pedìdos,	*He used to give me many orders.*

Disjunctive pronouns follow prepositions, as :

Para, por, de, á, *for, by, of, to,* etc.

	Sing.	*Plur.*
1.	mí, *me.*	nosòtros, nosòtras, *us* (m.), *us* (f.).
2.	tí (fam.), *thee.*	vosòtros, vosòtras (fam.) *you* (m.), *you* (f.) (fam.).
3.	él, èlla, V., *him, her, you* (polite).	èllos, èllas, Vs., *them* (m.), *them* (f.), *you* (polite).

Reflexive pronouns may be conjunctive (joined to the verb), disjunctive (not joined), or (for emphasis) both, as :

1.	Lavàrme á mí, *to wash myself* (adding literally, *to myself*).	Lavàrnos á nosòtros (-as), *to wash ourselves.*
2.	Lavàrte á tí (fam.), *to wash thyself.*	Lavàros á vosòtros (-as), *to wash yourselves* (fam.).
3.	Lavàrse á sí, *to wash himself, herself, yourself* (polite).	Lavàrse á sí, *to wash themselves, yourselves* (polite).

de, pàra, etc., sí, *of, for,* etc., *oneself, himself, herself, themselves, yourself, yourselves.*

conmígo, *with me.*
contígo, *with thee.*
consigo, *with oneself, himself, herself, themselves, yourself, yourselves.*

The reflexive form of the verb is often used instead of the passive voice, so that in Spanish the latter can be expressed in two ways, viz. : **Estos géneros son vendidos en Manchester,** or **Estos géneros se vènden en Manchester,** both meaning, *These goods are sold in Manchester*, though literally the second phrase reads, *These goods sell themselves*, etc.

Se díce que la càsa ha quebràdo, Or—	*It is said that the house has failed.*
Dicen que la càsa ha quebràdo,	*They say that the house has failed.*
Se dícen mùchas còsas fàlsas,	*Many false things are said.*

In Spanish a transitive verb governs a person in the dative, though the feminine **la** is often used instead of **le.**

¿ Llevan Vs. dinèro consìgo ?	*Have (carry) you any money with you ?*
Dándomelas V. hoy, recibirán èllos las contestaciònes mañàna,	*By (your) giving them* (las càrtas, etc.) *to me today, they will receive the replies to-morrow.*
Les dàmos á Vs. la preferència,	*We give you the preference.*

Remark : this double form of the pronoun is commoner in Spain than in Spanish-speaking America.

Mándennoslos Vs.,	*Send them to us* (literally, send to us them) (*Affirmative* Imperative).
No nos los mànden Vs.,	*Do not send them to us* (*Negative* Imperative).
Se la màndo á èllos, *or* se la màndo (la muèstra, etc.),	*I send it to them.*
¿ Cuándo me enviará V. la lètra ?	*When will you send me the bill* (of exchange) *?*

The possessive-adjectival pronouns are :—

mi	mis	*my.*
tu	tus (fam.)	*thy.*
su	sus	*his, her, your* (polite).
nuèstro, -a	nuèstros, -as	*our.*
vuèstro, -a	vuèstros, -as (fam.)	*your* (fam.).
su	sus	*their, your* (polite).

Corresponding pure pronouns are :—

el mío la mía los míos las mías
mine.

el túyo la tùya *thine.*	los tùyos	las tùyas	
el sùyo la sùya *his, her, its, yours.*	los sùyos	las sùyas	
el nuèstro la nuèstra *ours.*	los nuèstros	las nuèstras	
el vuèstro la vuèstra *yours.*	los vuèstros	las vuèstras	
el sùyo la sùya *theirs, yours.*	los sùyos	las sùyas	

No article is required—

(*a*) In reply to a question, as :

¿ De quién son èstos géneros ? *Whose are these goods?*
¿ **Nuèstros** ? *Ours?*

(*b*) Where a verb is inserted between the Noun and Pronoun, as :

Èste dibùjo es mío, *This design is mine.*

If, however, the article appears in such cases, it is for emphasis, as :

Èsta muèstra es **la sùya**, *This pattern is yours (his, hers, theirs).*
¿ Quière V. dàrme su plùma ? *Will you give me your pen?*
Mi clièntе ha liquidàdo su cuènta, *My customer has settled his account.*
Han suspendido sus pàgos èsta mañàna, *They have suspended their payments this morning.*

Demonstrative adjectives or **pronouns.** These include :—

1. èste, èsta, *this ;* èstos, èstas, *these* (near the speaker).
2. èse, èsa, *that ;* èsos, èsas, *those* (near the person addressed).
3. aquèl, aquèlla, *that ;* aquèllos, aquèllas, *those* (away from both persons).

When pure pronouns, they often take the acute accent, as :

No es **èste** nuèstro surtìdo, *This is not our assortment.*
No quièro èste dibùjo, sìno **aquél**, *I do not want this design, but that.*
Èsto ó éso sería mejòr que **aquéllo**, *This or that* (near you) *would be better than that* (yonder).

Remark : When no gender comes into question, these neuter forms (ending in **-o**) are used.

VOCABULARY

pòrque, *because.*
á tièmpo, *in time.*
entònces, *then.*
el nòmbre, *the name.*
sièmpre, *always.*
inútil, *useless.*
afligìrse de, *to trouble oneself about.*
la mèsa, *the table.*
la tàrde, *the afternoon, evening.*
liquidàrse, *to liquidate itself, to be liquidated.*
comparàrse, confrontàrse *to compare themselves, to be compared.*
lo futùro, *the future.*
bañàrse, *to bathe, to take a bath.*
el àgua (f.), *the water.*
frío, fría (f.), *cold.*
el mòdo, *the way, manner.*
el amìgo, *the friend.*
empleàr, *to employ, to use.*
español, -a (f.), *Spanish.*
exportadòr, -a (f.), *exporting.*
hallàr, encontràr, *to find.*
son, *are.*
càro, *dear* (of price).
costòso, *costly, expensive.*
negociàrse, *to negotiate themselves, to be negotiated.*
á razón de, *at the rate of.*
los detàlles, los pormenòres, *the details, the particulars.*

The Verb.—The endings of the Past Definite, Indicative Mood, are :

	yo	tú	él, èlla, V.	nosòtros (-as)	vosòtros (-as)	èllos, èllas, Vs.
1. Compr-	é	àste	ó	àmos	àsteis	àron.
2. Vend- | 3. Supl-	í	ìste	ió	ìmos	ìsteis	ièron.

cotizar, *to quote.*
muchísimo, *very much.*
mènos de, *less than.*
el chelín, *the shilling.*
Sud-América, *South America.*
el día, *the day,*
llevàr, *to take, carry.*
el consèjo, *the advice, council, counsel.*
despedìrse, *to take leave, say good-bye.*
querèr, *to wish, will, like.*
Vd. quière, *you wish.*
sìno, *but* (in contradiction of a previous negative phrase).
dejàr de (followed by an infinitive), *to cease to.*
suspendèr, *to suspend.*
declaràrse en quièbra, *to declare oneself (themselves) bankrupt.*
saldàr sus lìbros, *to balance their books.*
mostràr *or* exponèr su posición, *to show their position.*
dèsde entònces, *since then.*
mùchas vèces, *many times, often.*
ejecutàrse, *to execute themselves, to be executed.*

Exercise 7

Translate into English :—

1. Las muèstras pequèñas se enviarán la semána que viène. 2. No se las mandàmos hoy, pòrque no las tenèmos. 3. Enviándoselas á Vds. entònces, las recibirán á tièmpo. 4. Sírvase Vd. decìrme su nòmbre. 5. Lo bueno de èsto es que sìrve para sièmpre. 6. Es ìnútil afligìrse de lo pasàdo. 7. Hay que pensár en lo futùro y dejàr lo pasàdo. 8. Me baño tòdas las mañànas en àgua fría. 9. Les he dìcho (à èllos) mi mòdo de pensàr. 10. Mi amìgo me dice que está empleàdo en ùna càsa exportadòra española. 11. Si Vd. tiène èste artículo, sírvase dárnoslo al prècio menciònado. 12. Les hèmos cotizàdo (á Vds.) èste prècio àntes de la Guèrra. 13. Ahòra han subìdo muchísimo los prècios. 14. No se còmpran èstos géneros á mènos de cìnco chelines la pièza. 15. Se vènden aquí mùchos artículos pàra Sud-América. 16. En nuèstro despàcho se escrìben càrtas tòdo el día.

Exercise 8

Translate into Spanish :—

1. If I receive the letters this morning, I will give them to you. 2. This is not for me, but (sìno) for you. 3. That is not for us, but that (yonder) that you see on the table. 4. This is your assortment, which will be sent (reflexive) this afternoon. 5. My account will be settled (reflexive) and passed (reflexive) without fail to-morrow. 6. This pattern is yours (emphatic), it is not mine. 7. This design is ours, and we shall give it to you as you wish (it). 8. Whose are these designs ? Mine. 9. These goods cannot be compared (tr.: compare themselves) with ours (emphatic).

A. C.

Continued from Vol. IV., page 484.

GEOGRAPHY:

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ASIA.—I

Asia is the largest of the continents of the globe. In size it exceeds by about a million square miles the entire area of the New World, and it is only about the same area short of being equal to the whole of the rest of the world. The total area of Asia is some seventeen millions of square miles, the coast-line is about 44,000 miles long, and the centre of the continent lies over 1,600 miles from the sea.

In the north the continent is plunged in continuous night for some weeks in each year at Cape Chelyuskin; at its southern extremity 5,400 miles away at Cape Romania, only 90 miles from the Equator, day and night are nearly equal.

On three sides Asia is bounded by the ocean; the Arctic on the north, the Pacific on the east, the Indian on the south. On the west the boundary between it and Europe is a more or less arbitrary one, being formed by the Ural Mountains (not much more than a low range of hills the mean height of which is some 1,500 feet), the Ural River, the Caspian Sea and the Caucasus Mountains. In the Isthmus of Suez the canal only separates Asia from Africa.

General Shape

In general shape Asia is quadrangular with its four sides facing the four cardinal points of the compass, and this quadrangular outline is only broken to any great extent by three huge peninsulas to the south, the Arabian, the Indian and the Indo-Chinese, thus showing a rather curious similarity to that of the south of Europe with its three peninsulas of Spain, Italy and the Balkans. The parallel may be taken even further, for Arabia like Spain is an elevated plateau with a but slightly indented coastline; India like Italy is sheltered from the north by great mountains, has ranges running north and south, and a large island at its southern extremity; the Indo-Chinese peninsula like Greece extends into an island-studded sea.

Above one quarter of Asia lies below 650 feet, and nearly a quarter of a million square miles lies actually below the sea level. On the other hand about one seventh of the whole area is over 6,600 feet high.

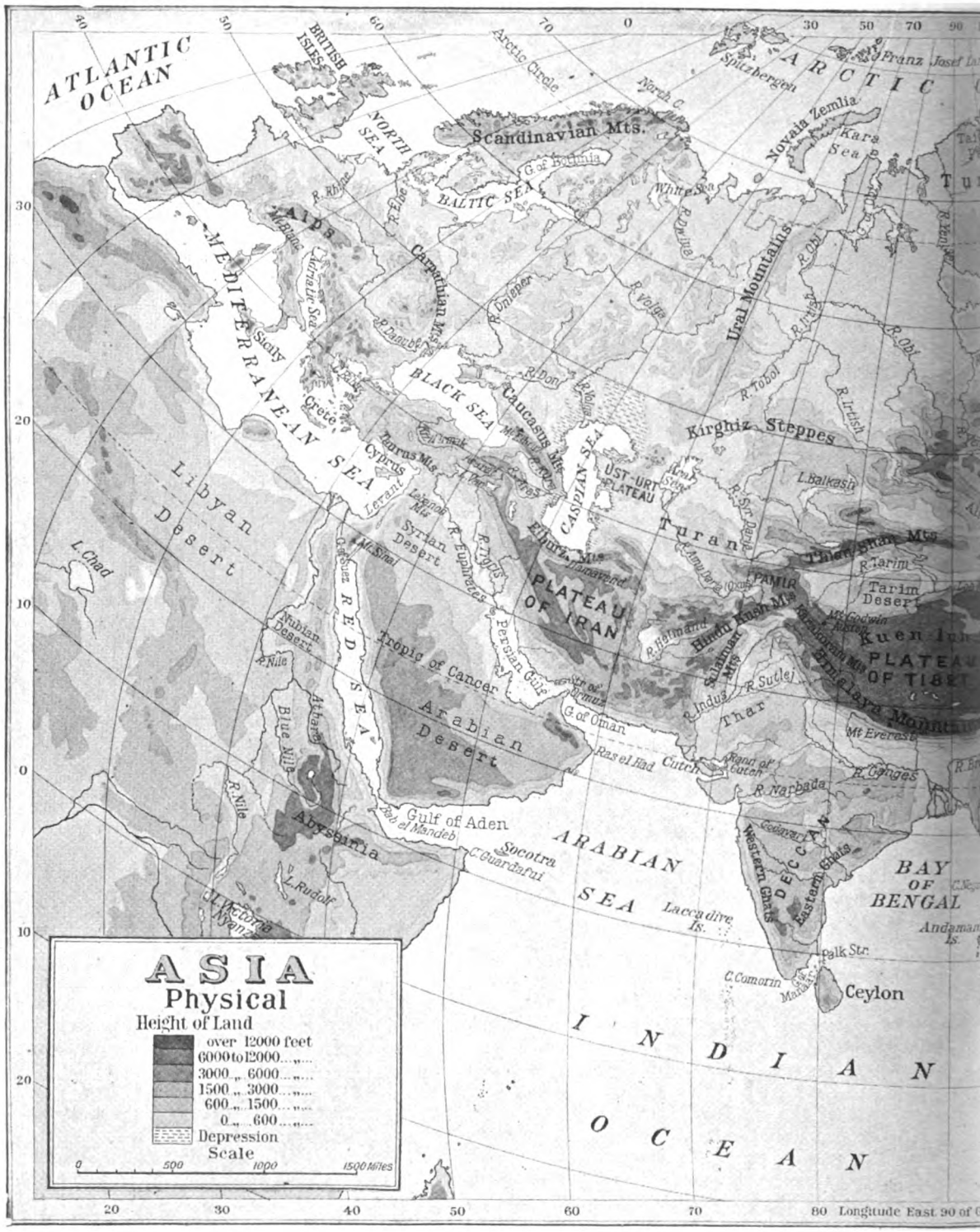
Natural Divisions

Speaking broadly the lowlands lie to the north, and the highest land rather to the south of the centre. The continent can, however, be roughly divided into four great natural divisions: (1) The Northern Lowlands, (2) The Central Mountain System, (3) The Eastern Escarpments and (4) The Southern Tablelands, including Arabia and India.

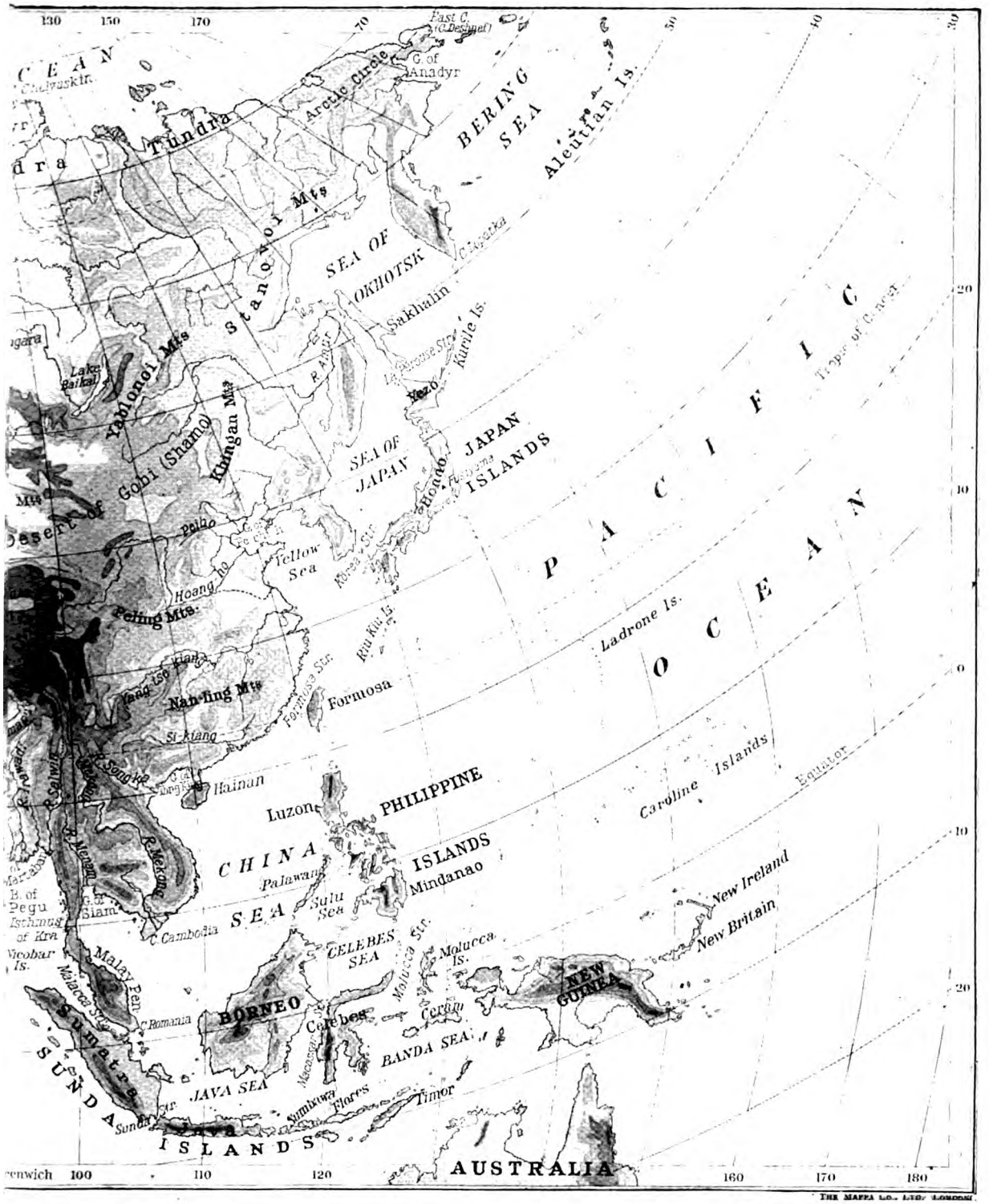
The Northern Lowlands lie roughly north of a line drawn from the Sea of Okhotsk, which lies to the west of the peninsula of Khamchatka, to the Caspian Sea, which is some 85 feet below sea level. The northern-most portions of this vast expanse lie within the Arctic Circle, and for hundreds of miles consist of the Tundra, a dreary waste, frozen for nine months of the year and in many parts permanently frozen to a considerable depth. The western portion of the lowlands consists of the plains around the Caspian and Aral Seas; they are low and for the most part sandy, the rivers either evaporating or entering lakes which have no outlet. The more northerly part of this westerly division of the lowlands is the flat and marshy district lying between the Ural Mountains and the River Yenisei.

The Central Mountain System exhibits the largest and the highest tableland in the world. It has a mean altitude of from 6,000 to 15,000 feet, and over it tower the mountain ranges of the Himalaya, Kuen-Lun, Tian-Shan and Altai, broadening and extending west to east from the Caucasus, through the Elburz and Hindu-Kush Ranges and the Pamir plateau.

From Cape Dezhneff in the extreme north-east of the Behring Sea is a series of seven crescent-shaped escarpments; the most northerly is formed by the Stanovoi



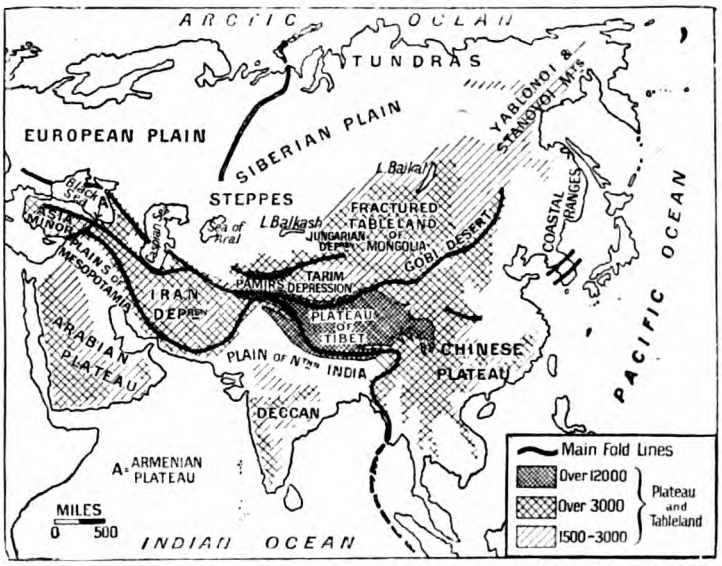
Asia is the largest of the continents. Its total area is some 17,000,000 square miles, exceeding that of the quarter of a million square miles of the continent lie below sea level. The great plateaux, on the



entire New World by about one million square miles. The coast line is about 44,000 miles long. Nearly a other hand, have several peaks rising to over 25,000 feet, the highest being Mount Everest (29,000 feet).

mountains; the eastern and southern limits of Yunnan, in China, the seventh. Between these features lie great depressions, in part actually forming the eastern seas such as the Sea of Okhotsk, the Japan Sea, the China Sea, etc.

The Southern Tablelands.—The Arabian tableland lies between the Red Sea and the Persian Gulf, which is prolonged into the plains of the Euphrates and Tigris valleys. It has a mean elevation of about 3,000 feet. The Deccan stretches out to the southward of the Himalaya and is of an average height of two to three thousand feet. The third, the Indo-Chinese peninsula, lies between the Bay of Bengal and the China Sea.



By permission of Messrs. Harrap & Co.

STRUCTURAL MAP OF ASIA.

At the extreme west are the Caucasus Mountains separating Asia from Europe. This range, which has somewhat of the definitive characteristics of the Pyrenees, is about 900 miles long and averages 12,000 feet high. Centrally it attains its greatest development rising in Elbruz with a twin peak, to over 18,000 feet, in Kosh-tan-tau to about 17,000 feet and in Kazbek to 16,550 feet. There are no passes lower than 10,000 feet.

To the west this range is prolonged into the Armenian highlands of which the loftiest peak is Mount Ararat, where, according to tradition, the Ark rested. This high ground skirts the Black Sea, gradually becoming less elevated as we pass westward. Midway between the Black Sea and the Caspian is the great Darial gorge, through which the Terek River rushes, confined by huge granite cliffs from 5,000 to 6,000 feet high, and through this gorge runs the military road from Vladikavkaz to Tiflis.

Eastward the Caucasus is prolonged into the Elburz range, which culminates in Demavend some 19,000 to 20,000 feet high. The northern slopes of these mountains, enjoying an abundant rainfall, are very fertile, but the southern slopes giving on to the deserts of North Persia are barren. The chief pass leading from the Caspian Sea to Teheran, in Persia, is over 7,000 feet high.

Farther eastward, connected by ranges of lower mountains and hills rise the Hindu-Kush, but the district between these and the Elburz Mountains has been but little explored.

The Himalaya

The Hindu-Kush may be looked upon as a westward prolongation of the Himalaya, separated from them by the Indus gorge. They extend for some three or four hundred miles up to the Pamirs in a north-easterly direction and really consist of a series of parallel ranges having a breadth of about 200 miles. The highest peak is Tirach Mir, over 25,000 feet high on the frontier of Chitral.

At this point the mountain system of Asia is at its broadest and most complicated. A glance at the skeleton map appended may make the disposition fairly clear if it be remembered that the thick lines are to be looked upon as guides only. The great plateau of the Pamirs, in the north-east, may be looked upon as a focus from which radiate the Himalaya to the south-east, the Hindu-Kush to the south-west and the Tian Shan to the north-east.

The name Himalaya is derived from the Sanskrit, and signifies "abode of snow." For a great part of their length they do not form a range of mountains so much as an entire mountain system of several parallel ranges with offshoots and spurs in different directions. Broadly speaking, they may be said to extend from a point where the Indus takes a southward bend after running north-west, to the point where the Brahma-

pootra takes a southward bend after running east and south-east—a distance of some 1,600 miles, the average breadth being about 200 miles.

For a great part of this length three parallel ranges may be recognised. The most southerly portion or foothills, known as the Siwalik, rise to about 3,000 feet. Behind this to the north are the outer Himalaya, rising from 8,000 to 9,000 feet, and here are found the Indian hill stations, such as Simla, Naini Tal, Darjeeling, etc.

Behind this again is the central Himalaya, whose mean height is about 20,000 feet. The highest peaks are not, however, found on the main range but frequently occur at the ends of the spurs or offshoots. The Himalaya attains its greatest heights between the Sutlej, which has worn a deep gorge just to the north of Simla, and the region of Bhutan. Several of the peaks are over 25,000 feet high, and the highest are Mt. Everest (29,000 feet) and Kinchinjunga (over 28,000 feet).

Owing to their great height the passes across the Himalaya are few and difficult, those of the chief ranges being generally above 18,000 feet high. If we bear in mind that the snow-line on the Himalaya is at about 15,000 feet on the Indian side, and that the vast extent of mountainous and rocky country is absolutely barren and almost arctic in its climate, we can well appreciate the abnormal difficulties of crossing.

SEEN FROM DARJEELING.

A striking study in snow and cloud effects on the mighty Himalaya as viewed from India's popular hill station.

The Karakoram Mountains form a link between the south-eastern corner of the Pamirs and the north-western angle of the Tibetan plateau. This range is separated from the Himalaya by the long depression formed by the Indus, here flowing towards the north-west. Its length is about 450 miles and at about the centre rises Mt. Godwin-Austen, the second highest peak in the world, 28,278 feet. Several peaks close by are over 25,000 feet. The great Baltoro glacier, 33 miles long, is also in this district, as well as other large glaciers.

The Karakoram Mountains form the true watershed between the inland Asiatic north-

ward drainage to the Aralo-Caspian basin or into Tibet, and the southern-flowing streams to the Indian Ocean.

The Kuen-Lun Mountains form the northern boundary of Tibet; on the west they diverge from the Karakoram range, divide into parallel chains, and run nearly due east for about 2,300 miles, ending in the province of Honan, China.

The Tian Shan Mountains, with their prolongations, form the northern boundary of the Pamirs and separate Chinese from Russian Turkestan. This range also consists rather of a series of ranges both parallel and having diverging spurs. The loftiest peak is Khan-Tengri, about 24,000 feet high.

The Altai Mountain System

All the foregoing ranges may be considered to be part of the great central Asian *massif*, and it now remains to consider those ranges that are more or less separated from the main upheaval centres. The Altai mountain system begins at its western extremity at the north of Lake Zaisan, and can be followed with interruptions and under differing names wellnigh up to the Bering Strait. The Great Altai branch running towards the south-east enters Mongolia. The western portion, or Altai proper, which lies more or less between the head-waters of the Irtish and Yenisei, is not so much a true range as a series of ranges running in various directions. The mean altitude of these mountains is only about 5,000 feet, though in Mt. Byelukha it attains a height of 14,000 feet. For about 200 years gold, silver and copper have been mined here.

Active Volcanoes

Following the Altai Mountains we come to the Yablonoi and Stanovoi ranges, neither of which attain any great altitude. The Khamchatka Mountains traverse the whole length of the peninsula, and there are no less than fourteen still active volcanoes in this range, the highest of these volcanoes being over 16,000 feet high. This famous peak—Kluchevskaya—being almost constantly in eruption. This range forms part of the volcanic girdle of the Pacific.

The Indo-Chinese peninsula is covered with a number of mountain ranges running mostly in a north and south direction, but the country has been insufficiently explored up to the present to give any coherent idea of their actual distribution or even of the sources of the rivers. In India, apart from the Himalaya, the chief mountains are the Eastern and Western Ghats, which form the boundaries of the Deccan. They are neither of any considerable height. They converge, south of Mysore, in the Nilgiri Hills, which are noted for their pleasant climate and are a resort for Europeans seeking relief from the great heat of the plains of India. C. J. S.

Photo: Sir John Foster Fraser.

MOUNT ARARAT (16,969 feet)

as seen from Erivan: the lofty peak which, according to tradition, was the first ground touched by the Ark as the Flood subsided.

Continued from Vol. IV., page 491.

MATHEMATICS:

Contributor: – ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.
(M. A. Lewenz, M.A.[Lond.]).

TRIGONOMETRY.—V

44. ALL the formulæ which connect the functions of $n\frac{\pi}{2} \pm \theta$ can be proved geometrically, as we shall now show by means of a few examples.

Examples :—

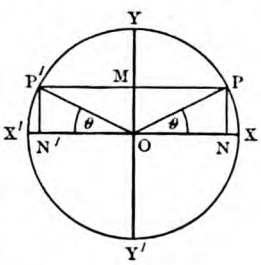
(1) *To show that* sin (180° − θ) = sin θ and cos (180° − θ) = cos θ.

Let a line rotate about O from the position O X in a positive sense through an angle θ to the position O P.

Let another line rotate about O from the position O X in a positive sense through the angle 180° and then in a negative sense through the angle θ so that it reaches the position O P′

Then ∠ X O P = θ and the ∠ X O P′ = 180° − θ.

O P, O P′ have the same projection O M on Y Y′



$$\sin(180° - \theta) = \sin \text{X O P}' = \frac{\text{O M}}{\text{O P}'} = \frac{\text{O M}}{\text{O P}}$$

$$= \sin \text{X O P} = \sin \theta.$$

Again the projection of O P on X X′ is O N, and the projection of O P′ on X X′ is on O N′.

We can prove that triangle P O N = triangle P′ O N′ in all respects ∴ O N = O N′ *in magnitude.*

But O N and O N′ are opposite in direction

∴ O N = − O N′.

Now cos (180° − θ) = cos X O P′

$$= \frac{\text{O N}'}{\text{O P}'} = \frac{-\text{O N}}{\text{O P}} = -\cos \text{X O P}$$

$$= -\cos \theta.$$

(2) *To show that* cot (270° − θ) = tan θ.

Let a line rotate about O in the positive sense through the angle θ to the position O P.

Let another line rotate about O in the positive sense through the angle 270° and then in a negative sense through the angle θ, so that it reaches the position O P′. Then ∠ X O P = θ and ∠ X O P′ = 270° − θ.

O M, O M′ are the projections of O P, O P′ respectively on Y Y′; and O N, O N′ are the projections of O P, O P′ respectively on X X′.

Since the triangles O P N, O P′ M′ have the ∠s O N P, O M′ P′ each equal to a right angle, and the ∠ P O N = θ = ∠ P′ O M′ and the hypotenuse O P = O P′

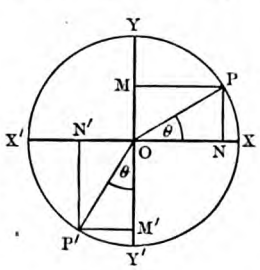
∴ the triangles are equal in all respects and ∴ O N = O M′ *in magnitude* and N P = M′ P′ *in magnitude.*

Now N P = O M, and M′ P′ = O N′

∴ O M = O N′ *in magnitude.*

Now we see that as long as P is on the same side of X′ X as Y, P′ is on the same side of Y Y′ as X′

∴ when O M is positive, O N′ is negative.



Again as long as P is on the same side of Y Y′ as X, P′ is on the same side of X X′ as Y′

∴ when O N is positive, O M′ is negative.

Hence we have O N = − O M′ and O M = − O N′.

Now cot (270° − θ) = cot X O P′

$$= \frac{\text{O N}'}{\text{O M}'}$$

$$= \frac{-\text{O M}}{-\text{O N}} = \frac{\text{O M}}{\text{O N}} = \tan \text{X O P} = \tan \theta.$$

Exercise 8

Prove geometrically

(1) sin 60° = sin 120°. (2) cos 320° = − cos (− 140°). (3) sin (− 40°) = sin 220°.

If A, B, C be the angles of a triangle (i.e. A + B + C = 180°) show that (4) sin C = sin (A + B). (5) cos A = − cos (C + B). (6) cos C = − cos (A + B + 2C). (7) $\sin \frac{\text{C} - \text{A}}{2} = -\cos \frac{\text{B} + 2\text{C}}{2}$.

45. If cos θ = x then the angle θ is called an inverse cosine of x. Thus if cos θ = $\frac{\sqrt{3}}{2}$, then $\frac{\pi}{6}$, $\frac{11\pi}{6}$, $\frac{13\pi}{6}$, . . . $\frac{-\pi}{6}$, $\frac{-11\pi}{6}$, $\frac{-13\pi}{6}$ and so on are each of them an inverse cosine of $\frac{\sqrt{3}}{2}$.

The following notation is usually adopted: $\cos^{-1}x$ denotes an angle whose cosine is x. The angle which is numerically smallest whose cosine equals x is called the *principal* value, and it is this value which is ordinarily denoted by $\cos^{-1}x$.

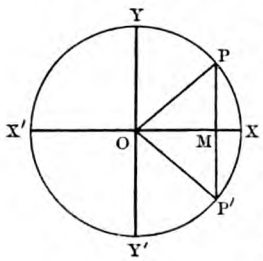
Similarly we have $\sin^{-1}x$, $\tan^{-1}x$, $\sec^{-1}x$, etc.

Thus $\sin^{-1}\frac{1}{\sqrt{2}} = \frac{\pi}{4}$, $\cos^{-1}\left(-\frac{1}{2}\right) = \frac{2\pi}{3}$, $\tan^{-1}\infty = \frac{\pi}{2}$ and so on.

46. *To find an expression for all angles with a given cosine.*

Let x be the given cosine.

Describe a circle with centre O and radius O X equal to unity. On O X take a length O M such that O M = x in magnitude and sense. Through M draw the chord P M P′ perpendicular to O X. Join O P, O P′.



Then all angles bounded by O X and O P, and all angles bounded by O X and O P′ have the cosine x.

Now if α be any one of the angles bounded by O X and O P, all the other angles bounded by O X and O P differ from this angle by some multiple of 4 right angles.

Hence all angles bounded by O X and O P are included in the form $2n\pi + \alpha$

where $n = 0$ or any positive or negative integer.

Again $\angle$s X O P and X O P′ are equal in magnitude but contrary in sense, $\therefore \angle$ X O P $= -\angle$ X O P′ and therefore one of the angles bounded by O X and O P′ is $-\alpha$.

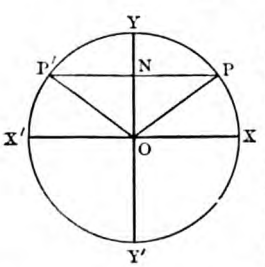
Therefore all the angles bounded by O X and O P′ are included in the form $2n\pi - \alpha$

where $n = 0$ or any positive or negative integer.

Putting the two forms together we have $2n\pi \pm \alpha$.

Hence if $\alpha = \cos^{-1}x$

$\cos^{-1}x = 2n\pi \pm \alpha = 2n\pi \pm \cos^{-1}x$.



In the special case where $x = 1$, P and P′ coincide with X and hence $\cos^{-1}1 = 2n\pi$.

If $x = -1$, P and P′ coincide with X′ and hence $\cos^{-1}(-1) = (2n+1)\pi$

if $x = 0$, P and P′ coincide with Y and Y′ and hence $\cos^{-1}0 = 2n\pi \pm \frac{\pi}{2}$, or $m\pi \pm \frac{\pi}{2}$.

47. *To find an expression for all angles with a given sine.*

Let x be the given sine.

Describe a circle with centre O and radius O X equal to unity. Draw Y Y′ through O perpendicular to X′ X. On O Y cut off O N = x in magnitude and sense.

Through N draw the chord P N P′ perpendicular to O Y. Join O P, O P′.

Then all angles bounded by O X and O P, and all angles bounded by O X and O P′ have their sine = x.

Now if α be one of the angles bounded by O X and O P then all other angles bounded by O X and O P differ from this angle by some mulitiple of 4 right angles.

Hence all angles bounded by O X and O P are included in the form $2m\pi + \alpha$

where $m = 0$ or any positive or negative integer.

Again, $\angle$s X O P and X′ O P′ are equal in magnitude, but opposite in sense.

Hence one of the angles bounded by O X and O P′ is $\pi - \alpha$ and therefore all the angles bounded by O X and O P′ are included in the form $2m\pi + \pi - \alpha = (2m+1)\pi - \alpha$

where $m = 0$ or any positive or negative integer.

Now consider the 2 forms $2m\pi + \alpha$ and $(2m+1)\pi - \alpha$.

We see that when we have an even multiple of π we add α, and when we have an odd multiple of π we subtract α.

Hence we may include both in the form

$n\pi + (-1)^n\alpha$

where n is zero or any positive or negative integer.

Hence if $\alpha = \sin^{-1}x$, then $\sin^{-1}x = n\pi + (-1)^n \sin^{-1}x$.

In the special case where $x = 1$, P and P′ coincide with Y, and hence $\sin^{-1}1 = 2n\pi + \frac{\pi}{2}$.

Where $x = -1$, P and P′ coincide with Y′ and hence $\sin^{-1}(-1) = 2n\pi - \frac{\pi}{2}$.

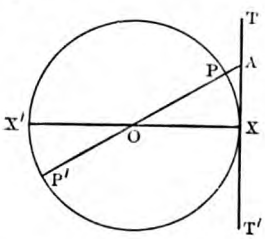
Where $x = 0$, P and P′ coincide with X and Y′ and hence $\sin^{-1}0 = n\pi$.

48. *To find an expression for all angles which have a given tangent.*

Let x be the given tangent.

Describe a circle with centre O and radius O X equal to unity. Through X draw T T′ at right angles to O X. Let the direction in which the point of intersection of a line rotating in a positive sense round O would move be the positive sense of T T′.

On X T cut off X A equal in magnitude and sense to X.



Join A O cutting the circle at P and P′.

Then all angles bounded by O X and O P, and O X and O P′ have their tangent = x.

Let α be one of the angles bounded by O X and O P, then all other angles bounded by O X and O P differ from this angle by a multiple of 4 right angles. Hence all the angles bounded by O X and O P are included in the form $2m\pi + \alpha$

where $m = 0$ or any positive or negative integer.

Again $\angle$s X O P and X′ O P′ are equal in magnitude and the same in sense; hence one of the angles bounded by O X and O P′ is $\pi + \alpha$.

Therefore all the angles bounded by O X and O P′ are included in the form $2m\pi + \pi + \alpha + (2m+1)\pi + \alpha$

where $m = 0$ or any positive or negative integer.

The two forms may be included in the form

$n\pi + \alpha$

where n is zero or any positive or negative integer.

Hence if $\alpha = \tan^{-1}x$, $\tan^{-1}x = n\pi + \tan^{-1}x$.

When $x = \infty$, $\tan^{-1}\infty = n\pi + \frac{\pi}{2}$.

When $x = 0$, $\tan^{-1} 0 = n\pi$

Exercise 9

Find expressions for all angles having
(1) a given secant. (2) a given cosecant. (3) a given cotangent.

49. Examples:—

(1) Solve the equation
$\sec^3\theta - 2\tan^2\theta = 2$.
Multiply throughout by $\cos^3\theta$
then $1 - 2\sin^2\theta\cos\theta = 2\cos^3\theta$
$\therefore 1 - 2\cos\theta(1 - \cos^2\theta) = 2\cos^3\theta$
$\therefore 2\cos\theta = 1$
$\therefore \cos\theta = \frac{1}{2}$
$\therefore \theta = 2n\pi \pm \frac{\pi}{3}$.

(2) Solve the equation
$\cot^2\theta(\operatorname{cosec}\theta - 1) = 1 + \operatorname{cosec}\theta$.
Multiply throughout by $\sin^3\theta$
then $\cos^2\theta(1 - \sin\theta) = \sin^3\theta + \sin^2\theta$
$\therefore (1 - \sin^2\theta)(1 - \sin\theta) = \sin^3\theta + \sin^2\theta$
$\therefore 2\sin^2\theta + \sin\theta - 1 = 0$
$\therefore (\sin\theta + 1)(2\sin\theta - 1) = 0$
$\therefore \sin\theta = -1$ or $\sin\theta = \frac{1}{2}$
if $\sin\theta = -1$, $\theta = n\pi + (-1)^n\frac{\pi}{2}$,
if $\sin\theta = \frac{1}{2}$, $\theta = n\pi + (-1)^n\frac{\pi}{6}$.

(3) Solve the equation
$\sin\theta + 2\cos\theta = 1$
$\sin\theta + 2\sqrt{1 - \sin^2\theta} = 1$
$\therefore 1 - \sin\theta = 2\sqrt{1 - \sin^2\theta}$
squaring, $\sin^2\theta - 2\sin\theta + 1 = 4 - 4\sin^2\theta$
$\therefore 5\sin^2\theta - 2\sin\theta - 3 = 0$
$\therefore (5\sin\theta + 3)(\sin\theta - 1) = 0$
$\therefore \sin\theta = -\frac{3}{5}$ or $\sin\theta = 1$.
If $\sin\theta = -\frac{3}{5}$, $\theta = n\pi - (-1)^n\sin^{-1}\frac{3}{5}$
if $\sin\theta = 1$, $\theta = n\pi + (-1)^n\frac{\pi}{2}$.

Exercise 10

Write down the complete solution of
(1) $\cos\theta = \frac{1}{2}$. (2) $\sin\theta = \frac{1}{2}$. (3) $\tan\theta = 1$. (4) $\tan\theta = -1$.
Solve the equations
(5) $\operatorname{cosec}\theta - 4\sin\theta = 2$. (6) $3(1 + \cos 3\theta) = 2\sin^2 3\theta$. (7) $\sqrt{3}(\operatorname{cosec}^2\theta - 2) + 2\cot\theta = 0$.

Circular Functions of two or more Variable Angles

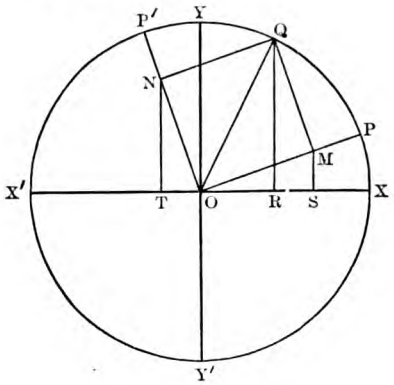
50. *To prove that* $\cos(\alpha + \beta) = \cos\alpha\cdot\cos\beta - \sin\alpha\sin\beta$.

Let O Y make an angle $\frac{\pi}{2}$ in the positive sense with O X.

Let a line rotate about O from the position O X through an angle α to the position O P; let it rotate further through an angle β to the position O Q.

Then angle X O Q $= \alpha + \beta$.

Let the line O P′ make an angle $\frac{\pi}{2}$ in the positive sense with O P.



Let M and N be the projections of Q on O P, O P′ respectively.

Let R, S, T be the projections of Q, M and N respectively on O X.

M Q is equal and parallel to O N and is the same in sense as O N.

$\therefore$ S R = O T in magnitude and sense.

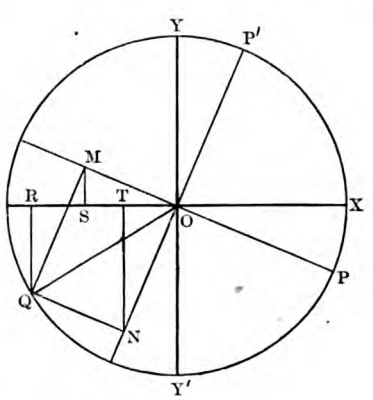
Hence O R = O S + S R
= O S + O T

$$\therefore \frac{OR}{OQ} = \frac{OS}{OM}\cdot\frac{OM}{OQ} + \frac{OT}{ON}\cdot\frac{ON}{OQ}$$

$$= \cos\alpha\cdot\cos\beta + \cos\left(\frac{\pi}{2} + \alpha\right)\sin\beta.$$

Now $\cos\left(\frac{\pi}{2} + \alpha\right) = -\sin\alpha$

$$\therefore \frac{OR}{OQ} = \cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$$



Changing β into $-\beta$ we get
$\cos(\alpha - \beta) = \cos\alpha\cos(-\beta) - \sin\alpha\sin(-\beta)$
but $\cos(-\beta) = \cos\beta$ and $\sin(-\beta) = -\sin\beta$
$\therefore \cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$
Now having proved that
$\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$ .. (1)
and $\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$ .. (2)
change α into $\frac{\pi}{2} + \alpha$ in the formulæ

then from (1)

$$\cos\left(\frac{\pi}{2}+\alpha+\beta\right)=\cos\left(\frac{\pi}{2}+\alpha\right)\cos\beta-\sin\left(\frac{\pi}{2}+\alpha\right)\sin\beta$$

but $\cos\left(\frac{\pi}{2}+\alpha\right)=\sin\alpha$, and $\sin\left(\frac{\pi}{2}+\alpha\right)=-\cos\alpha$

and $\cos\left(\frac{\pi}{2}+\alpha+\beta\right)=\sin(\alpha+\beta)$

hence $\sin(\alpha+\beta)=\sin\alpha\cos\beta+\cos\alpha\sin\beta$ . . (3)

Similarly from (2)

$\sin(\alpha-\beta)=\sin\alpha\cos\beta-\cos\alpha\sin\beta$ . . (4).

Thus we have proved the Addition Formula (1) to (4) of the circular functions, for all angles. It follows that the formulæ derived from those in Lessons II and III hold good, not only for acute angles, but for all angles. It is left as an exercise for the student to prove (3) and (4) geometrically.

51. *To find cos α and sin α in terms of cos 2α.*

We know $2\cos^2\alpha=1+\cos 2\alpha$ and $2\sin^2\alpha=1-\cos 2\alpha$

$$\therefore\ \cos\alpha=\pm\sqrt{\frac{1+\cos 2\alpha}{2}}$$

and $$\sin\alpha=\pm\sqrt{\frac{1-\cos 2\alpha}{2}}.$$

This gives us two values of cos α and two values of sin α in terms of cos 2α.

We can show that there must be two such values in the following way.

If 2α be an angle which has a given cosine then all the angles which have this cosine are included in $2n\pi\pm 2\alpha$.

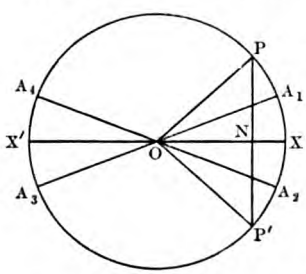
In finding cos α we are finding the cosines of all the angles included in the form $\frac{1}{2}(2n\pi\pm 2\alpha)$

i.e. $n\pi\pm\alpha$.

Now $\cos(n\pi\pm\alpha)=\cos\alpha$ if n be even; and $\cos(n\pi\pm\alpha)=-\cos\alpha$ if n be odd.

Hence we get two values of cos α and similarly two values of sin α in terms of cos 2α, which are equal in magnitude, but opposite in sign.

We may also show this geometrically.



If we have a circle of radius O X equal to unity, and from O X cut off O N equal to cos 2α, and through N draw the chord P P′ perpendicular to O X; then the angles bounded by O X and O P and O X, O P′ have their cosines = cos 2α.

By bisecting the angles bounded by O X and O P we get another two bounding lines for α, namely O A_1, O A_3.

Similarly by bisecting the angles bounded by O X and O P′ we get two more bounding lines for α; namely O A_2, O A_4.

It may be shown that A_1A_3 and A_2A_4 are diameters of the circle. Hence we have

$\cos\alpha=\cos$ X O $A_1=-\cos$ X O $A_4=-\cos$ X O $A_3=\cos$ X O A_2

$\sin\alpha=\sin$ X O $A_1=\sin$ X O $A_4=-\sin$ X O $A_3=-\sin$ X O A_2

that is, two values of cos α equal in magnitude and opposite in sign, and two values of sin α equal in magnitude and opposite in sign.

52. *To find cos α and sin α in terms of sin 2α.*

We know that $\cos^2\alpha+\sin^2\alpha=1$ . . . . (i)

and $2\cos\alpha\sin\alpha=\sin 2\alpha$ . . . . . (ii)

Adding (i) and (ii) we have $(\cos\alpha+\sin\alpha)^2=1+\sin 2\alpha$

subtracting (ii) from (i) we have $(\cos\alpha-\sin\alpha)^2=1-\sin 2\alpha$.

hence $\cos\alpha+\sin\alpha=\pm\sqrt{1+\sin 2\alpha}$ . . . . (iii)

and $\cos\alpha-\sin\alpha=\pm\sqrt{1-\sin 2\alpha}$ . . (iv)

adding (iii) and (iv) $\cos\alpha$

$$=\frac{1}{2}\left\{\pm\sqrt{1+\sin 2\alpha}\pm\sqrt{1-\sin 2\alpha}\right\}$$

subtracting (iv) from (iii) $\sin\alpha$

$$=\frac{1}{2}\left\{\pm\sqrt{1+\sin 2\alpha}\mp\sqrt{1-\sin 2\alpha}\right\}$$

This gives us four values of cos α and four values of sin α in terms of sin 2α. These values consist of two pairs, equal in magnitude and opposite in sign. We can show that there must be four such values in the following way:

If 2α be an angle which has a given sine, then all the angles which have this sine are included in the form $n\pi+(-1)^n 2\alpha$.

Hence in finding cos α we are finding the cosines of all angles included in the form $\frac{1}{2}\left\{n\pi+(-1)^n 2\alpha\right\}$

i.e. of $\frac{n\pi}{2}+(-1)^n\alpha$.

Now $\cos\left\{\frac{n\pi}{2}+(-1)^n\alpha\right\}$

$=\cos\alpha$ if $n=4s$

$=\sin\alpha$ if $n=4s+1$

$=-\cos\alpha$ if $n=4s+2$

$=-\sin\alpha$ if $n=4s+3$

where $s=0$ or any positive or negative integer.

Hence we get 4 values of cos α in terms of sin 2α and similarly 4 values of sin α in terms of sin 2α, these values consisting of two pairs, equal in magnitude and opposite in sign.

It is left to the student to show this geometrically.

53. The proper signs to be taken in the equations

$\cos\alpha+\sin\alpha=\pm\sqrt{1+\sin 2\alpha}$ . . . . (i)

$\cos\alpha-\sin\alpha=\pm\sqrt{1-\sin 2\alpha}$ . . . . (ii)

can be determined as follows:

If α lies between $2n\pi-\frac{\pi}{4}$ and $2n\pi+\frac{\pi}{4}$, cos α is always positive and greater in magnitude than sin α; ∴ we must take the + sign in (i) and (ii).

If α lies between $2n\pi+\frac{\pi}{4}$ and $2n\pi+\frac{3\pi}{4}$, sin α is always positive and greater in magnitude than cos α; ∴ we must take the + sign in (i) and the − sign in (ii).

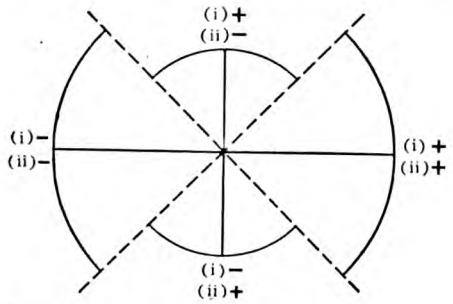
If α lies between $2n\pi+\frac{3\pi}{4}$ and $2n\pi+\frac{5\pi}{4}$, cos α

is always negative and greater in magnitude than sin α.

$\therefore$ we must take the $-$ sign in (i) and (ii)

If α lies between $2n\pi + \frac{5\pi}{4}$ and $2n\pi + \frac{7\pi}{4}$, sin α is always negative and greater in magnitude than cos α; $\therefore$ we must take the $-$ sign in (i) and the $+$ sign in (ii).

The following diagram illustrates this result:



Examples:—

(1) State the sign of cos α + sin α and of cos α − sin α when $\alpha = 290°$; cos α + sin α is negative; cos α − sin α is positive.

Exercise 11

State the sign of cos α + sin α and cos α − sin α when (1) $\alpha = 22°$. (2) $\alpha = 191°$. (3) $\alpha = 300°$. (4) $\alpha = \frac{2\pi}{3}$. (5) $\alpha = \frac{3\pi}{2}$. (6) Given that 2α lies between 450° and 63°, prove that $2\cos\alpha = -\sqrt{1+\sin\alpha} + \sqrt{1-\sin\alpha}$

(7) show that $\tan\alpha = \frac{-1 \pm \sqrt{1+\tan^2 2\alpha}}{\tan 2\alpha}$

Key to Exercise 7

(1) $-\cos\alpha$. (2) $-\cot\alpha$. (3) $-\sec\alpha$. (4) $-\tan\alpha$. (5) $-\cos\alpha$. (6) $\sin\alpha$. (7) $\frac{1}{2}$. (8) $-\frac{1}{\sqrt{2}}$. (9) $-\frac{1}{\sqrt{3}}$. (10) $\frac{2}{\sqrt{3}}$. (11) -1. (12) $-\frac{\sqrt{5}-1}{4}$. (13) -2.

M. A. L.

MECHANICS.—IX

50. The force of **Friction** enters into so many problems that we must say a few words of it here, though it does not lie within the scope of this course to deal with it in detail. Friction is called into play whenever one rough body slides over another, and as no body is perfectly smooth, it enters into all practical problems.

Measure of Friction.—The resistance due to friction clearly acts in the opposite direction to that in which the body tends to move. We may measure it in the following way.

If we wish to measure the friction between a body Q and a surface X Y, we place Q on the surface and attach to it a fine thread passing over a pulley at the edge of the surface and supporting at its free end the weight P. If the weight P causes Q to move, the work done on Q is all done against the force of friction since no work is done in lifting Q against the force of gravity. Therefore the least weight P which will cause Q to move is the measure of the friction between Q and X Y.

As the result of experiments it has been found:

(1) Friction depends on the nature of the surfaces, but is independent of the area of contact.

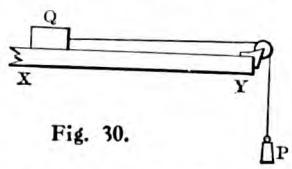


Fig. 30.

(2) Friction varies with the normal reaction between the surfaces in contact.

(3) Friction is independent of the velocity of motion.

These laws are only approximate, and the last in particular requires some modification. The ratio of the Friction to the normal Reaction when sliding is about to take place is called the coefficient of Friction and is represented by μ. Thus if the normal reaction be R, then the friction $F = \mu R$.

Of course μ varies with different substances.

Example:—

A body is projected along a rough horizontal plane with a velocity of 50 $\frac{\text{ft.}}{\text{sec.}}$; if the coefficient of friction between the plane and the body is $\frac{1}{10}$, how far will it move before coming to rest?

Let m = mass of body, then mg = its weight

$\therefore$ reaction of plane on body = mg

$\therefore$ force of friction = $F = \frac{1}{10}mg$.

$\therefore$ retardation due to friction = $\frac{\frac{mg}{10}}{m} = \frac{g}{10}$

Now $v^2 = 2as$ $\therefore$ $s = \frac{v^2}{2a} = \frac{2500}{\frac{2g}{10}} = \frac{12500}{32}$

$= 390\frac{5}{8}$ feet.

51. *The* **Energy** *of a body is its capacity for doing work.*

There are many kinds of energy, but we can deal here only with mechanical Energy, which is of two kinds, **Kinetic** and **Potential.**

52. **Kinetic Energy** applies to moving bodies.

All moving bodies possess energy, i.e. are capable of doing work. Thus a bullet fired at a wooden target will penetrate it and will do work against the resistance of the wood to penetration.

Again, running water will turn the wheel of a water mill, and thus its energy will be used to grind corn.

The **Kinetic Energy** *of a body is the energy it possesses by virtue of its motion and is measured by the amount of work the body can do against impressed forces before its velocity is destroyed.*

To find an expression for the **Kinetic energy** of a moving body.

Suppose a body of mass m is moving with velocity v. What work can it do in coming to rest?

If v is reduced to zero, there must be a retardation a, produced by some force F.

Suppose v is reduced to zero in a distance s.

Then $F = ma$ (i) $\left.\right\}$ $\therefore F = \frac{mv^2}{2s}$ $\therefore Fs = \frac{1}{2}mv^2$.
also $v^2 = 2as$ (ii) $\left.\right\}$

Now Fs = force × distance = work done against the resistance F.

$\therefore \frac{1}{2}mv^2$ = total work done against F, is a measure of the Kinetic Energy of the body of mass m. We see that the energy is expressed in dynamical units of work; i.e. in coming to rest the body does $\frac{1}{2}mv^2$ units of work, or **the kinetic energy of a body** $= \frac{1}{2}mv^2$.

Fig. 31.

In gravitation units, the kinetic energy of a body of mass m, moving with velocity $v = \frac{mv^2}{2g}$.

If in the distance s the resisting force F reduces the velocity v to a velocity u (instead of reducing it to zero) then we have $Fs = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$
$= \frac{1}{2}m(v^2 - u^2)$

i.e. work done by F = (final kinetic energy)
− (initial kinetic energy)
= (change in kinetic energy).

If the motion be uniformly accelerated, the final kinetic energy is greater than the initial, and in this case
the increase of kinetic energy is equal to the work done by the impressed force.

53. **Potential Energy.**—A body may possess energy even when at rest, by virtue of its position or the position of its particles. Thus suppose a large mass of water is stored in a reservoir at a considerable height above the ground; if this water is released it will descend, and in descending it will do work. It owes its energy or its capacity for doing work to the fact that it is stored at a height above the ground, i.e. it owes it to its *position*.

This energy which is due to position is called **Potential Energy,** and we may define it thus. *The* **Potential Energy** *of a body is measured by the work it can do by means of its position (or the position of its parts) in passing from its present position to a standard position (usually called its zero position).*

If a body of mass m is at a height h above the ground, its potential energy = mgh, i.e. its weight × its height. For if this body were attached to another body of mass m by means of a string passing over a pulley, the first body, in falling to the ground could raise the second body of weight mg through a height h; i.e. the work it could do if it fell = mgh foot-poundals.

Notice that Potential Energy is transformed into Kinetic Energy as soon as motion takes place.

54. *A particle of mass m falls from a height h to the ground: to show that the sum of its potential energy and its kinetic energy is constant through the motion.*

If H be the point from which it falls and O the point where it strikes the ground. Let the distance H P = x and the distance H O = h

Let v be the velocity when it reaches P
then $v^2 = 2gx$.

$\therefore$ at P, kinetic energy $= \frac{1}{2}mv^2 = mgx$

At P its potential energy = $mg(h - x)$

$\therefore$ the sum of its kinetic and potential energies at any point P = $mgx + mg(h - x)$ = mgh.

At H its kinetic energy is zero, and its potential energy is mgh. Thus the sum of the potential and kinetic energies at H and P are the same, and since P is any point in H O, the sum of the two quantities is the same throughout the motion.

At O the potential energy is zero, and the initial potential energy has all been transformed into kinetic energy.

55. The above is a simple case of the principle of **Conservation of Energy.**

The body at H must have been raised to that height, i.e. it has had work done upon it in the past. Thus the potential energy due to its position was communicated to it by some kinetic energy which did work upon it in the past. But when it falls, its potential energy is transformed into kinetic energy, and the sum of the two remains constant. Thus no energy has been created and no energy has been wasted, and this is what we mean by the principle of the **Conservation of Energy.**

Energy can neither be created nor be destroyed, but can only be transformed from one form to another.

Now there are many forms of energy:—There is the energy of vibration which gives rise to heat, light, sound; electrical energy; chemical energy.

Not all of these, however, can be converted into mechanical energy. Heat can be so converted at a high temperature as, for instance, when we drive a train by means of a steam engine, and thus the energy of heat is made to do work; but not all forms of energy are available for doing work. For instance, when the body in the above example reaches the ground, its impact with the ground will generate a small amount of heat at a low temperature; this is not lost, but may be said to be dissipated since we cannot make use of it.

The principle of the conservation of energy holds good only when we include all forms of energy and realise that though we may not be able to transmute every form into work, it nevertheless is not destroyed, but merely unavailable for our purposes.

56. It will be useful for the student to compare the results we have found for work and kinetic energy with Newton's Second Law of Motion.

We found (§ 36) $Ft = M$

i.e. **force × time = impulse = change of momentum.**

Again (§ 48) $F \times s = W$

i.e. force × distance = work.

And lastly (§ 52) work = change of kinetic energy

∴ **force × distance = work = change of kinetic energy.**

We may find the acceleration of the masses in Atwood's machine by means of the equation between work and energy. Let the mass of P $= m_1$, and the mass of Q $= m_2$ where $m_1 > m_2$ and let us assume that P, in falling through a distance s, has acquired a velocity v.

The total kinetic energy (K.E.) $= \frac{1}{2}(m_1 + m_2)v^2$ foot poundals.

Also work done by P in falling $= m_1 gs$ foot-poundals and work done by Q in rising $= -m_2 gs$ foot-poundals.

Since W = K.E.

$$\frac{1}{2}(m_1 + m_2)v^2 = (m_1 - m_2)gs$$

$$\therefore v^2 = \frac{2(m_1 - m_2)gs}{m_1 + m_2}$$

Now $v^2 = 2as$ $\therefore a = \dfrac{m_1 - m_2}{m_1 + m_2}g$

the same result as we get in § 45.

57. Examples on Work, Energy and Power, etc.

(1) A simple pendulum is pulled aside till its bob is raised 3 inches and is then let go. Find its velocity when it passes its lowest point.

Let the mass of the bob $= m$. In reaching its lowest point it descends 3 inches $= \frac{1}{4}$ ft. vertically

$\therefore$ work done by gravity $= \frac{1}{4}mg$.

Now work done = kinetic energy of bob $= \frac{1}{2}mv^2$

$$\therefore \frac{1}{2}mv^2 = \frac{1}{4}mg \therefore v^2 = \frac{1}{2}g = 16 \therefore v = 4 \frac{\text{ft.}}{\text{sec.}}$$

(2) A shot of 1000 lb. moving at 1600 $\frac{\text{ft.}}{\text{sec.}}$ strikes a fixed target. How far will the shot penetrate the target exerting upon it an average pressure equal to the weight of 12,000 tons?

(London Matric. Exam.)

Kinetic energy of shot $= \frac{1}{2}mv^2$

$$= \frac{1}{2} \times 1000 \times (1600)^2$$

If s = distance it penetrates, work done in overcoming resistance of target $= 12000 \times 2240g \times s$

K.E. = work done

$$\therefore \frac{1}{2} \times 1000 \times (1600)^2 = 12000 \times 2240 \times 32\, s$$

$$\therefore s = \frac{800 \times 1600}{12 \times 2240 \times 32} = 1{\cdot}49 \text{ ft. approximately.}$$

(3) A body is projected up a rough inclined plane which rises 1 in 10 with a velocity of 50 $\frac{\text{ft.}}{\text{sec.}}$. If the resistance due to friction is $\frac{1}{50}$ of the weight of the body, find how far the body will move up the plane.

Let m be mass of body, and s the distance it moves, kinetic energy of body on starting $= \frac{1}{2}mv^2$

$$= \frac{1}{2} \times 2500m = 1250m$$

Resistance due to friction $= \frac{1}{50}mg$

$\therefore$ work done against friction $= \frac{1}{50}mgs$

work done against gravity $= \frac{1}{10}mgs$

$\therefore$ total work done $= \frac{1}{50}mgs + \frac{1}{10}mgs = \frac{3}{25}mgs$

Now kinetic energy = work done

$$\therefore 1250\,m = \frac{3}{25}mgs \therefore s = \frac{1250 \times 25}{3 \times 32}$$

$= 325{\cdot}5$ ft.

Exercise 10

(1) What work must be done to propel a stone weighing 6 lb. at the rate of 40 ft. per sec.?

(2) Through what distance must a force equal to the weight of ½ lb. act upon a mass of 48·3 lb. in order to increase the velocity from 24 $\frac{\text{ft.}}{\text{sec.}}$ to 36 $\frac{\text{ft.}}{\text{sec.}}$?

(3) What is the kinetic energy acquired by (1) a mass of 10 lb. falling through 100 ft.; (2) a mass of 1 kilogram falling through 10 metres?

(4) A body weighing 40 lb. is projected along a rough horizontal plane with a velocity of 150 $\frac{\text{ft.}}{\text{sec.}}$; the resistance due to friction = ⅛ of the weight of the body. Find the work done against friction in 5 seconds.

(5) Find the horse-power of an engine which moves horizontally at the rate of 45 miles per hour, the weight of the engine and load being 100 tons and the resistance due to friction being 20 lb. per ton.

(6) Find the horse-power of an engine which raises 2,000 gallons of water an hour through a height of 300 ft. (1 gallon of water weighs 10 lb.)

(7) A train weighing 60 tons and moving at the rate of 40 miles an hour is stopped in 10 yards. What is the average force applied to stop it?

(8) A body weighing 3 tons slides down a plane which rises 1 in 20. It acquires a speed of 30 $\frac{\text{ft.}}{\text{sec.}}$ after sliding 500 feet down the plane. Find the average force of friction acting on it. What velocity would it have acquired if the plane had been perfectly smooth?

(9) A body whose mass is 100 grams is thrown vertically upwards with a velocity of 980 centimetres per second. What is the energy of the body (1) at the moment of propulsion, (2) after half a second, (3) after one second?

(10) Equal forces act for the same time on unequal masses M and m. What is the relation between (1) the momenta generated by the forces, (2) the amount of work done by them?

Key to Exercise 9

(1) 9800 centimetres. Vel. = 196,000 cms. per second. (2) The tension in the string is equal to ½ lb. weight; 6¾ oz. weight, 5¼ oz. weight. (3) Mass must be divided in the ratio of 19 : 13. (4) 60 poundals; 2 $\frac{\text{ft.}}{\text{sec.}^2}$. (5) 4·4 seconds. (6) 1 minute. (7) (*a*) 1 lb. (*b*) ½ lb. (*c*) 2 lb. (8) (*a*) The stone strikes the ground in ¾ of a second at a distance of 4½ ft. from the spot vertically below the centre of rotation; its path is a parabola. (*b*) Having a velocity vertically upwards it will behave like a stone thrown vertically up and will strike the ground after ·95 second.

M. A. L.

From the picture by Walter Crane.

PAN PIPES.

An enchanting study embodying the spirit of Mendelssohn's "Spring Song."

Continued from Vol. IV., page 494.

ART AND MUSIC:

Contributors **:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).**

MUSIC.—IX

We have already (Vol. IV., p. 176) discussed the inherent melodic and harmonic qualities of the pentatonic scale, as represented in the five black keys of the piano. Now, by felicitous chance, our eminent pianist is about to give us a dazzling illustration. It is Chopin's Fifth Study—known as the Study on the Black Keys—that he has begun. Listen! How the notes seem to glance and flash from the piano, like rays from a glass dancing in the sunlight.

Fascinating, is it not?—and brief; for there, it is ended. The flickering mirror has vanished. You would like more. Well, the next piece is also by Chopin, but it is on a bigger scale. It is a Polonaise.

Études

The Études (studies) are twenty-seven in number; most of them are deeply expressive of some phase of human emotion, or some aspect of Nature.

Listening sympathetically, we find the Twelfth Study does indeed convey a grim and acute impression of the fiery passion and the pain aroused by the fall of Warsaw. The meaning of such an Étude as that known as "The Winter Wind" is more obvious, for in this case the music does to some extent simulate the sounds of Nature.

The Polonaise is a characteristic national dance, of the time when Poland was a kingdom and the monarch was elected by acclamation of the panoplied armies on the plains of Warsaw.

This polonaise is an idealisation, of course—an epitome rather than a dance, imbued with the chivalry and grandeur of a court that existed in Chopin's imagination.

The pianist is evidently gratified by the applause. He returns and reseats himself. It is a little "Song Without Words," by Mendelssohn, that he plays. Some call it "The Farewell." We think it has not been chosen by chance.

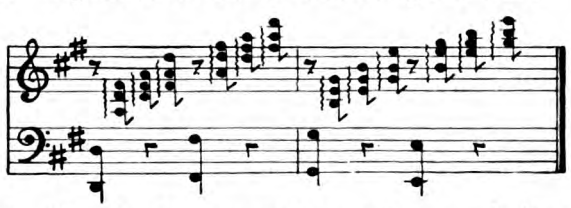
There is poignance in the little piece—the "farewell" has a sob in it. Now, perhaps we had better leave before the audience settles down again. We can talk about the "Songs Without Words."

They have gone a little out of fashion with the leading pianists of late, and as players in the second rank all follow the leaders, the public seldom hear these gems of Mendelssohn's art. Yet they cover a very wide range of sentiment and expression.

Mendelssohn's "Spring Song"

The serious amateur pianist, who will take pains, and will really master two or three of them—for example, No. 15 ("The Harp of the Poet"), No. 13 ("Evening Star"), No. 25 ("May Breezes"), No. 36 ("Serenade"), or No. 9 ("Consolation"), to say nothing of the dainty "Spring Song" and the bewitching "Bees' Wedding" (or "Spinning Song")—will have at command something which will give real satisfaction.

It may, by the by, be interesting to repeat a story, familiar to few, of the genesis of that graceful "Spring Song" which attracts so many and is seldom mastered. Whilst the composer was on one of his English visits and was staying at a friend's house, he was one morning a little disturbed by the piano-practice in the next room of a young member of the family, who was steadily pursuing a useful but monotonous repetition of chords—something like this:



The chords came with merciless regularity; and as he was unable to continue his reading,

Mendelssohn found solace in fitting a few bars of melody to the perpetual harmony. He liked the tune that had come to him, jotted it down, and it became the foundation on which the dainty "Spring Song" grew up.

Now, what we have to consider is how soonest and best the proficiency to play such things—or any pieces, it may be—on the piano can be attained. Well, before efficiency is reached, as all who have acquired it know—yes, even the specially gifted—there is persistent and prolonged work to be done in preparation. The proper performance of classical piano music demands an equivalent *technique*—to use a word commonly employed.

By technique we mean those physical acts which are carried out on the keys and pedals of the piano by means of the fingers, hands, wrists, arms, ankles, and feet; for all these have to be considered. It is according to the perfection of our technique—that is, according to the practised co-ordination of our physical movements, coupled with our hearing and the perception of touch in our fingers—that we are able to get from the strings of the piano the right kind of tone at whatever pace we wish.

Proper Technique

With proper technique we can get melody and chords, soft or loud, slow or rapid, tender or passionate—music possessing, indeed, all of the host of qualities which, as we know, can be produced by such an expert as we have heard.

To do this, however, a certain other kind of accomplishment has also to be added to the training of our hands—and feet. This is the accomplishment of the trained eye. It has indeed very much to do with good piano-playing. Blind men, of course, often play exceptionally well. But they have first to see with someone else's eyes. And the quicker your eyes are, and the healthier you keep them, the better you will play, even when you play from memory.

A trained and observant eye is an essential factor in enabling you

(1) mentally to grasp the grouping, time, and rhythm of the notes, bars, and phrases of the music, as you pass your eyes over the staves; and

(2) by the action of your brain, through nerves and muscles, on your hands, to cause your fingers on the piano keys to reproduce from the strings (the wires) the ideas you have conceived about the music.

Reading well "at sight," in which so many players in domestic circles fail, is an acquirement certainly within the reach of all those piano students with an alert eye and quick perception.

All can pleasantly surprise themselves by their progress, if they will take the trouble to write out on music-paper those passages which cause the trouble. Face the notes resolutely; examine the arrangement; make yourself quite familiar with the passage. Something like it is sure to meet you on another occasion, maybe in another key.

And if you have really mastered the difficulty its reappearance will only give you a sense of satisfaction at being able to play the passage smoothly and clearly. H. G.

WATER COLOUR DRAWING.—III

You should always bear in mind that brushwork only begins when pencil work is *completely* ended. You should also remember that brushwork cannot be learnt in an hour. A brush requires far more control, by its very nature, than a pencil, and constant practice is necessary in order to learn its limitations, its possibilities; perpetual exercise in its use is needed before you can really rely on a brush doing the work that you mean it to do. You can use it as a fine point, you can spread it out gently to make broad strokes, but it all needs constant work and exercise and good sound drawing beforehand and an out and out knowledge of the subject you are treating.

When you wish to put in flat tones you ought to hold your brush at an angle of forty degrees or so, but when little touches are needed you should, in order to get the best use of the sharp point, hold it almost vertically to the paper.

Now turn your attention to the sketch on p. **47.** Use it as an exercise and still keep to the use of sepia.

Make your drawing complete in every detail, and put in the sky first of all moderately light. Be careful about the clouds. At first it will be difficult not to cramp yourself when guiding the brush round and about these clouds without breaking over their edges. But freedom and lightness of touch come only with perpetual exercise.

Remember always that too little colour in your brush is apt to cause the edges to dry too quickly; so quickly, in fact, that they become hard and insoluble before you have time to soften them with the next brushful. You must wash your brush in clean water, let some of the water out by drawing

it over your blotting-paper, and then soften the lower edge of your first strokes.

In this particular case the sky consists of only one tone. There are no shadows. There are shadows, however, in the sketch on p. 48. Those parts of the clouds which are turned away from the source of light are marked B B. These should be painted in a tone rather fuller than that first used. Then as you get nearer to where the light is you take off the edges as before.

be darker than the broad shadow on the facing walls for the simple reason that light is reflected from the ground to the walls and causes the broad shadows thereon to be lighted.

In the middle distance there is a hedgerow which is of the same tone as the front wall, for it is in about the same position with regard to the sun. The trees on either side of the gate are darker than anything you have yet touched. Be careful that you allow the sky to be seen here and there through

A valuable study to be carried out in sepia. In order to make water look like water you must put sky light in it. The reflection of the building will help to create the appearance. The letters *a a a* indicate that the clouds face the source of light: cf. the sketch on p. 48.

Do not take off your edges by gradating them evenly, but *break* them with a brush no more than just damp. Then wash a rather light tone over almost all the lower part of the sky beneath the clouds. There should be no very strong lights or deep shades in this part, as that would tend to make the lower part of the sky look as though it were in front of the clouds, whilst as a matter of fact it should naturally appear *behind* the clouds. Great care must be taken with aerial perspective as with any other.

Of course, it often happens in the evening when the sun is setting that the lower clouds become intensely bright with the low sun rays. Notice that the upper part of the sky in the sketch on p. 48 is of the same tone as the far hills, whilst the middle distance is the same as the shadows on the clouds, and the foreground is dark. The hills which stand in the distance in the first sketch are done in the same way as those of the sketch on p. 48.

You will observe also that in the former sketch the front of the building which faces you is of a rather darker tone. It is in shadow and throws a shadow before it, because the sun is behind the building. The cast shadow on the ground must

the trees. That will depend entirely upon accurate pencil drawing in the first instance. The trees are nearly all dark, save where towards the extremities of the branches the light falls on or through the leaves.

Remember that the whole of the building is darker than the sky. A light tone should be washed over the side of the tower as well as the roof; and use the same tone for the broad shadow on the walls facing you.

In order to represent the water so that it looks *like* water, you must put the light by the sky in it. But of course the reflection of the building and of the bushes before it will help you greatly to give the appearance of water. The tone which you use for the shadow on the house is the tone to use for the reflection in the water. In painting this draw your brush directly *towards you*, and bear always in mind that the end of the reflection should be perpendicular to the end of the object reflected; that is to say, the left hand end of the house runs in a straight line up and down with the reflection of itself, only divided by the ground between and the bank beneath which the water lies.

Where a darker tone is needed in the reflection put it on before the first wash is quite dry. The

darkest bits of all are in the two trees and certain parts of the foreground in front of them. These should be carried out principally with the fine point of the brush.

The old advice about trying, trying, trying again after each successive failure must be remembered. You cannot expect to jump into perfection in a day or in many days.

Exercises such as those described above will teach you many things and will serve to point out difficulties in your path that you would never have perceived for all the telling in the world *before* you tried to apply precept to performance.

Natural Colours

We pass now from exercises in sepia to the use of natural colours.

Colour laid on with a brush must always be governed mainly by each student's individual skill, appreciation, inspiration, ability. But of course there are certain broad principles to bear in mind.

In the first place, all composite colours are derived from primary colours, which are three in number—yellow, red and blue. From these three are derived all kinds of combinations according to the proportion in which you mix them.

Of course, there are several kinds of red, as there are of yellow and of blue. But I shall deal with the names of these colours in their broad sense to start with.

Mix yellow with blue and you get green; yellow with red and orange is the result; blue with red and you have purple. Green, orange and purple are called secondary colours. These again may be mixed and sub-mixed and other tints are derived from them.

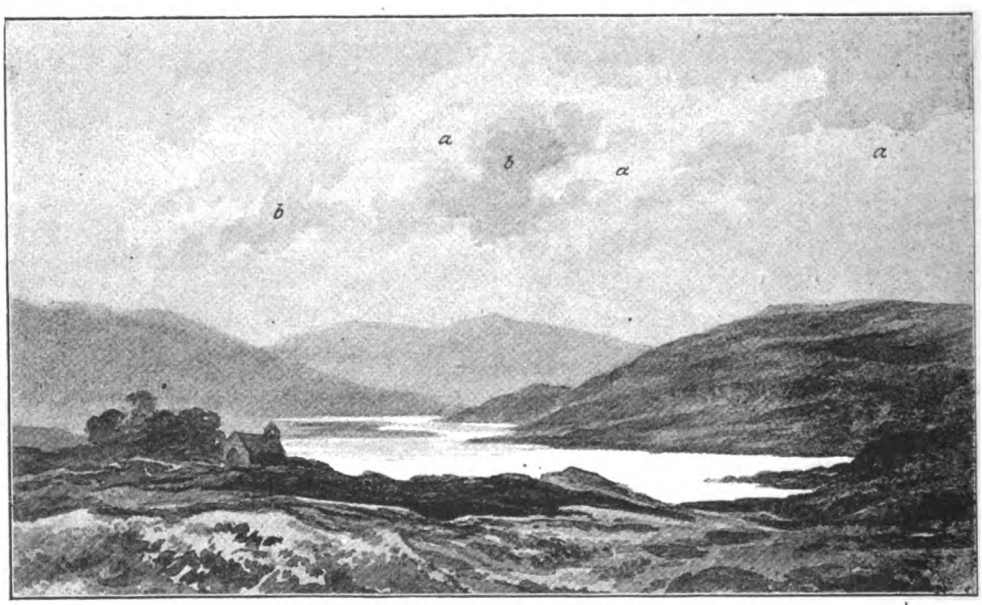
In point of fact you do not need in practice to derive all your colours from the process of mixture. You have a box with a large number (but not too large) already made into cakes.

So important will you find these mixtures of colour that it is not at all a bad scheme to take a sheet of paper and exercise yourself in producing various shades. You can at the same time go in for a purely *brush* exercise by gradating the tones.

Neutral Tones

Rule off a sheet in squares of about two inches and fill these with gradated tones of every combination of colour you are likely to require in any piece of landscape you happen to observe. When you have finished one square, cut it out from the sheet with a pair of scissors, so that your eye may not be confused.

Neutral tones such as grey may be warm or cold in the same manner. Only in all neutral tones the difference will be much more subtle than in positive colours and the distinction in this case will require a larger amount of exercise. J. G. B. L.



Another study in water, light, and shade. Clouds marked *a* face, and those marked *b* turn away from, the source of light. **Cf. p 47.**

Continued from Vol. IV., page 504.

BUSINESS AND COMMERCE

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

COMMERCIAL TRAINING.—XXIX

SALESMANSHIP is very largely a matter of self-education and of thoughtful experience. Upon it solely depends success as a retailer, for it is of no use being the most calculating buyer and possessing the finest business imaginable without being able to sell well.

Successful Salesmen

Self-education as a factor in success with salesmanship is of far greater importance than would appear at first sight. In its application to business, the education should consist of a deep and thorough knowledge and insight concerning the trade itself.

It is only by possessing this knowledge and insight that a salesman can interest a customer in his wares; and the young man who takes up any trade should make a point of teaching himself its many ramifications from end to end.

For this reason, the student of salesmanship should make it his business to subscribe to the leading trade journal; and to study the technical articles it contains, as well as the advertisements. At every opportunity, he should go through factories and wholesale warehouses; and should be ever ready to make comparisons between articles of similar type produced by dissimilar means, and to discuss trade matters with commercial travellers and others in touch with the production side of the business.

Good salesmanship can lead a very long way; but the average, everyday, mediocre salesman has very little chance of ever rising beyond his grade. An employer can take two roundsmen and send them off in different directions to canvass orders; and one will return with double the amount of orders of the other. There is a reason for this disparity, and it is the purpose of this lesson to bring that reason to light.

In the first place, to deal with the question of courtesy and civility. It goes without saying that the salesman must always be civil and always courteous. At the same time, there is the other extreme, which amounts to servility, to a cringing diffidence, and a total lack of self-confidence that simply repels a customer.

Again, this perfect courtesy and confident manner are not to be retained solely for the customer who is well dressed. From the point of view of the retailer, the poor person's money is quite as good as that of his richer neighbour; and no assistant should possess one set of manners for the rich and another for the poor. Nor should a poor person be expected to stand aside for one who is well-to-do.

And no assistant should fall into the trap of recommending a low-priced article to a customer because he happens to be shabbily garbed. In retail businesses, there should be no class distinction as between assistant and buyer; and too much attention cannot be paid to this particular point.

Honesty and Policy

When selling a cheap article, never make the sweeping statement that it is "just as good" as something at a far longer price. It is *not* just as good; and the customer will soon find out, if he does not realise it at the moment. Far better to suggest that the particular article represents very good value at the price asked.

This sort of thing, this cheery but deceitful optimism about goods to be sold, is a fatal bar to continued success as a salesman. True, it may sell the particular article; but the effect upon future sales is almost certain to be marked. In order to effect a sale no salesman should wrongly describe an article, making it out to be what it is not.

Then again, there is that innate sense with which all good salesmen are equipped, and which they must do their utmost to develop—that knowledge of human nature that counts for so much. A good salesman will know all the different types of customer, and precisely how to deal with them—

the quick, alert, businesslike man who knows what he wants, gets it, and goes; the man who hardly knows his own requirements, but who depends upon the salesman to explain to him what it will be best for him to buy; the fussy person who *thinks* he knows what he wants, but really does not do so, and who is so difficult to assist and to lead to a satisfactory sale; the smart person who knows more about the trade than the assistant himself, and so on.

The good salesman will quickly get to know all the types; and will realise precisely how to deal with each.

No good salesman makes it apparent that he is anxious to effect a sale. The moment an assistant becomes too pressing in his efforts to sell he has lost the art of salesmanship.

The wise salesman will know when the customer has bought just as much as he is likely to purchase. Beyond this point the assistant must stop; but prior to it he may interest and lead on the buyer with all the subtlety he can command. The wisdom of the whole proceeding is that every customer must emerge from the shop fully and well satisfied with the attention he has received, with the goods he has bought, and with the shop generally. A. B.

CHOOSING A CAREER.—XXXIII

Mercantile Marine (*continued*).—It stands to reason that the apprenticeship system gives social advantages to the young sailor; and these benefits are considerable on passenger-carrying vessels.

At the same time, it may be pointed out that apprenticeship is not a positive necessity in order to become an officer in this service. Many a smart youngster has, by starting when quite young and following the methods of self-education, risen to be an officer from the lowest ranks; for a boy may go to sea as an ordinary deck-hand and rough it with the crew "before the mast." In this capacity he will have to wait upon the men and to make himself generally useful on board the ship. His quarters will be in the forecastle, and his food that of the men; whereas the apprentice will probably have accommodation with the officers and mess in their room.

Provided the boy deck-hand can put up with rough life, and the many discomforts of the fo'c'sle, there is no reason why, as he grows older, he should not become a fully qualified seaman or A.B., and then a petty officer of some sort or other; and, if he can pass examinations, no one can stop him from becoming a certificated officer by the time he reaches the prescribed age.

He will have to depend very largely upon his own efforts, however, to acquire the purely technical knowledge of the sea—the "book-learning," as it were—unless by his personality he can make himself such a favourite with the officers that they will afford time upon occasions to give him tuition. And, so far as wages are concerned, the deck-hand will certainly earn a great deal more than the apprentice.

Deck-hands, cabin boys, bell boys and other beginners at sea should seek the advice of the superintendent of the Mercantile Marine office at the nearest port to their homes. These offices are established partly with the purpose of looking after the interests of those who are engaged in the Mercantile Marine service.

Pursers at sea are the men who have charge of the ship's stores, money and provisions. They rank as officers, and, to some extent, may be said to perform the clerical work of the ship. To become a purser, it is usual to begin as a purser's clerk; and such positions are often obtainable by consulting the superintendent at Mercantile Marine offices at the principal ports, and, in some instances, by writing to the head offices of the steamship companies. Those who have been clerks in shipping offices are most likely to find posts.

Stewards at sea are the men and boys who wait upon the officers and passengers, cleaning their cabins and performing what may be termed the domestic work of the ship. The pay is far better than it was years ago; and, in good ships, tips and gratuities are not inconsiderable. Men who have been waiters or who have served on the staffs of hotels stand the best chance of acceptance; and would-be stewards should inquire at the nearest Mercantile Marine office, should write to the chief steward at the head offices of the steamship companies, or should visit the docks and make personal application to the officers of incoming vessels.

Similar remarks apply in the case of *stewardesses*. At the same time, a word of caution may well be given to would-be stewards and stewardesses to be on their guard when people hold out to them the promise of appointment on payment of a substantial premium. In some instances this is merely a thin veneer to a system of fraud.

On the biggest liners all sorts of trades are

represented among the staff carried. There will be bakers, butchers, cooks, liftmen, barmen, hairdressers and, in some cases, even bandsmen and musicians. Applications for appointment in one or other of these capacities are always more satisfactorily attended to when addressed direct to the general manager at the head offices of the particular steamship company. It is not as a rule a good plan to make personal application on board the vessels for such posts.

In these days of steam, and with heavy oil and internal combustion engines being more used every year, it stands to reason that there is a constant opening for marine engineers; and the service offers many opportunities. *Engineers* rank as officers, usually mess with the executive, and receive similar allowances for provisions. As with the navigating officers, so with the engineers—there are two ways of attaining to the position; one the high-school method, and the other a system of graduation through sheer practical experience.

To deal with the former, the would-be engineer should have received his early education at a good secondary school, preferably at a technical school where instruction is given in workshop class-rooms.

From this point, the student may pass to one of the universities where mechanical engineering is taught; or he may go direct to the workshops of a firm of marine engineers ashore. In either event, whether he goes to college or not, he will have to put in a certain time in shore yards, for it is part of the training of a marine engineer that he shall be apprenticed for one, two or three years to an engineering firm, the period varying according to the technical schooling and general education.

For this apprenticeship, a premium has naturally to be paid, varying according to the nature and standing of the firm; in some instances part of the premium is returned in the form of small wages; but in many instances no wages at all are paid.

At the close of the apprenticeship, however, it is possible for a young engineer to obtain a post as third engineer in a steamer and to earn from £10 to £15 a month, according to the size and business of the ship. At the age of nineteen an apprentice may enter for the examination to qualify him for a position as second engineer; and the examination for chief engineer may be taken two years later. Full details of these tests are to be obtained from a government booklet entitled *Regulations Relating to the Examination of Engineers in the Mercantile Marine.* It may be obtained from *H.M. Stationery Office, Imperial House, Kingsway, London, W.C.2.*

Second engineers are paid from £15 to £25 a month, according to the size of their vessel and its work; and chief engineers may receive from £20 to £40 a month, the latter figure by no means a maximum on the large liners. Many young men serve a few years at sea after their shore apprenticeship to qualify for shore positions of responsibility in the yards of marine engineering firms.

The rank and file connected with the engines of a steamer are composed of *stokers, greasers, engine hands* and *boys.* These classes of workers should seek posts at the port offices of the steamship companies and through the superintendents of Mercantile Marine. The boys are employed to wait upon the engineers; in some cases to clean brass, and for similar duties; there are many ship's chief engineers who began their careers in this humble capacity. At any rate, there is nothing to bar a young man of a lower rating from sitting at one of the official examinations to pass the tests arranged for gaining an engineer's certificate. Everything will depend in these cases upon the ability of the worker and upon the steps he has taken to ensure such self-education as will see him safely through the tests.

Ship's doctors—and most passenger liners carry their own surgeons—receive their appointments from the head offices of the companies; and many young doctors who have recently emerged from their studentship elect to commence their careers by spending a year or two at sea. Normally, the work is by no means arduous, and the young doctor gains all the advantages of travel and experience without expense.

Vacancies for ship's doctors are often advertised in the medical press; and a letter to the general manager of a steamship company at head offices will often bring a favourable response.

It may be said that, broadly speaking, there are two systems of service in the Mercantile Marine. One may enter the employ of one or other of the big steamship companies with the idea of remaining in the service of that company as an actual career; and some of the firms offer a little in the way of a pension to certain grades of their workers.

On the other hand, one may become a sort of "freelance," engaging with a vessel for a round voyage, and, as soon as that voyage has terminated, seeking another and, if possible, a more important ship. A. C. M.

BOOK-KEEPING.—XXVII

THE manufacturing and trading accounts are used by a business man for the sake of comparisons. They do not include all items of cost, and therefore cannot be termed "Cost Accounts," as these must comprise all direct and indirect cost expenses.

Cost Accounts and Percentages

Some commercial houses calculate the relationship between various items of cost of production in the form of percentages, and draw up comparative tables which make it possible for leakages to be traced. Some item must be used as a standard, and for this purpose "net sales" are generaliy taken to represent 100.

The following actual Trading and Profit and Loss Account is of interest as an example of a percentage account and as being the actual accounts of a shirt manufacturing company. The accounts are practical, but like many actual business accounts they are open to criticism. The accounts consist of a so-called Manufacturing Account and a Profit and Loss Account, together with Schedules grouping items of cost. The scheduling allows the **totals** of establishment charges to appear in the Profit and Loss Account without the complication of detail. The example is really a Manufacturing Account not followed by a Trading Account, and therefore necessarily arriving at Gross Profit.

Note that the sums of the debit items in the Profit and Loss Account exceed gross profit by the credit items, Rents and Bad Debts recovered. Hence the total percentage exceeds the 15·98% representing gross profit.

Consider and criticise the accounts following :—

THE X Y Z MANUFACTURING Co., LTD.

MANUFACTURING AND PROFIT AND LOSS ACCOUNT

YEAR ENDING MARCH 31, 19..

Dr.									*Cr.*
% on Sales	COST	£	*s*	*d.*		PRODUCTION	£	*s.*	d.
59·63%	MATERIALS As per schedule "A"	39,154	4	–		SALES (Less difference in stocks)	65,660	14	4
15·33%	WAGES (Piece-work) Cutting, Sewing, etc.	10,065	14	10					
3·27%	WASHING AND DRESSING	2,148	15	4					
2·84%	LABELS, BOXES, ROPE AND TWINE	1,862	7	11					
2·26%	FACTORY WAGES (Time)	1,481	6	2					
·69%	CARRIAGE Inwards	452	15	10					
	Total Cost	55,165	4	1					
15·98%	Gross Profit	10,495	10	3					
100		£65,660	14	4			£65,660	14	4

Dr.									*Cr.*
	Establishment Charges	£	*s.*	*d.*	15·98%	Gross Profit	£ 10,495	*s.* 10	*d.* 3
4·59%	Factory As per Schedule "B"	3,012	18	11	·11	Rents Receivable	69	3	11
3·59%	London Office As per Schedule "C"	2,359	8	–		Bad Debts Recovered	4	4	6
3·26%	Miscellaneous As per Schedule "D"	2,139	0	11					
	Total	7,511	7	10					
4·65%	Net Profit	3,057	10	10					
16·09%		£10,568	18	8	16·09%		£10,568	18	8

THE X. Y. Z. MANUFACTURING Co., Ltd.

Schedule "A" Materials Consumed—Year ended March 31, 19..	£	s.	d.
Flannel, Oxford and Print	37,685	19	9
Calico, Linen and Canvas			
Sewing Cotton, Buttons, Studs, etc. ..	1,468	4	3
59·63 % on Sales	£39,154	4	–

Schedule "B" Factory Charges—Year ended March 31, 19..	£	s.	d.
Manager	271	15	5
Clerk in Office	76	5	–
Repairs to Buildings	92	19	8
,, ,, Plant (including depreciation)	450	18	4
Gas, Water and Fuel	408	0	5
Engine Oil and Sundries	147	2	9
Carriage	724	10	8
Insurance	144	1	–
Poor and District Rates	92	5	8
Income Tax—Schedules "A" and "B"	19	7	1
Stationery, Paper, etc.	215	18	7
National Health Insurance	279	10	7
Trade Expenses	90	3	9
4·59% on Sales	£3,012	18	11

Schedule "C" London Office Expenses	£	s.	d.
Managing Director's Salary ..	635	–	–
Directors' Fees	105	16	8
Secretary—Salary and Commission ..	639	17	–
,, Allowance	57	10	3
Clerk	120	–	–
Junior Clerk	63	–	–
Accountants	157	10	–
Rent	187	–	–
Travelling Expenses	215	14	5
Subscriptions and Donations	99	2	9
Telephone	21	–	–
Depreciation on Furniture	5	–	–
Sundries	52	16	11
3·59% on Sales	£2,359	8	–

Schedule "D" Miscellaneous Expenses—For year ended March 31, 19..	£	s.	d.
Discount and Interest	1,057	5	6
Commission	861	14	9
Interest on Mortgage	37	13	4
Bad Debts	65	–	–
Income Tax—Schedule "D"	117	7	4
3·26 % on Sales	£2,139	0	11

It will be noticed that the item "power" is not included in the Manufacturing Account, but it is peculiar to the business that power is charged against employees and is a deduction from "piece rates," hence the **wages** item is not net.

Gas, water, fuel and oil might well appear as manufacturing items, but the amounts only represent ·7% of the total charges. Item "National Health Insurance" represents the employer's contribution; the employee's contribution is included in "Wages."

Managing Director's remuneration and Directors' fees could have been charged in Appropriation Account.

Notice also that opening stock is not shown, but that Sales are given "less difference in stocks." It is better to show opening stock and stock in hand in Manufacturing Account.

Exercise

The John Smith and Steel Nib Co., Ltd., was registered on and took over the business of John Smith as from January 1, 19... John Smith sold his business to the Company upon the following valuation :—

	£	s.	d.
Buildings (on Leasehold premises with 21 years to run from Jan. 1, 19..)	7,500	–	–
Machinery and Plant	11,650	–	–
Stock and Materials	3,872	–	–
Goodwill	10,000	–	–

The Company took over the Book-debts which John Smith guaranteed, while he discharged the liabilities existing on Dec. 31, 19... The Company was registered with a Nominal Capital of £80,000, divided into 80,000 shares of £1 each. Of these 25,000 fully-paid shares were allotted to the Vendor as part consideration for the sale of the business, the balance being paid to him in Cash. Twenty thousand shares were offered to, subscribed, and fully paid by the Public, with the exception of two hundred shares, on which 10s. per share had been paid, and which were forfeited during the year 19.., by resolution of the Board of Directors, owing to the non-payment of the final call of 10s. per share. The books were closed on December 31, 19.., and stock taken as on that date, amounting to £6,760.

You are required to write off one-twentieth of the value of the buildings (to provide for the expiration of the Lease); 8% of the Machinery and Plant (as depreciation); one fourth of the Preliminary Expenses; and 5% from the Book Debts (as provision against bad and doubtful debts); and then prepare the Company's Trading Account and Profit and Loss Account for the year to December 31, 19.., and Balance Sheet as on that day. The balances of the Ledger Accounts then, in addition to those resulting from the above transactions, were :— (not to be copied)

	£	s.	d.
Purchases	35,720	–	–
Rent	76	–	–
Rates and Taxes	211	–	–
Wages	8,241	–	–
Salaries	917	–	–
Manufacturing Expenses	2,163	–	–
Sales	49,798	–	–
Returned Purchases	311	–	–
Returned Sales	763	–	–
Discounts Received	561	–	–
Discounts allowed (of which £239 were allowed on debts, which were guaranteed in full by John Smith, and are payable by him) ..	1,033	–	–
Office Expenses	1,006	–	–
Directors' Fees	200	–	–
Sundry Debtors	12,380	–	–
Sundry Creditors	4,467	–	–
Preliminary Expenses	400	–	–
Bad Debts (of which £187 were in respect of the debts guaranteed by John Smith, and are payable by him)	206	–	–
Cash at Bank	3,599	–	–
Auditors' Fees	100	–	–

State what dividend you would recommend to be paid to the Shareholders, and what balance of Profit and Loss Account would be carried forward to the next year.

(Royal Society of Arts.)

Definitions of Terms

A Trading Account has already been explained in Lesson 5 as an account framed to ascertain gross profit. We may add to this a broad statement that a Trading Account technically deals with finished or **manufactured goods,** whilst a Manufacturing Account deals with manufacture from **raw materials.**

A **"Manufacturing Account"** or "Cost of Production Account" does not aim at ascertaining gross profit, but at ascertaining cost of production. Value of goods is then carried to Trading Account at cost. When combined with the Trading Account, as it is in most examination tests and indeed in practice, it is framed to ascertain gross profits and is usually called a "Trading Account."

A **Cost Account** may or may not form part of a system of double entry book-keeping. It contains all items of cost such as appear in the Manufacturing or Trading Account and also such as appear in the Profit and Loss Account. Thus the cost of certain goods produced will include a proportionate part of management remuneration, rent, rates, income tax, lighting, repairs, renewals, depreciation, etc. Since the actual amount to be charged to production of specific goods could only be calculated with difficulty, a percentage which has been found by experience to be fairly accurate is charged (*see* example given).

The **price** of articles is made up thus :—

Actual	Raw material consumed ..	£
	Wages (Factory or Works, so-called productive) ..	£
Calculated percentages	**Add** Works Establishment Charges (works on cost)	£
	Add Administrative Charges (office on cost)	£
Desired	**Add** Profit	£
	Selling Price	

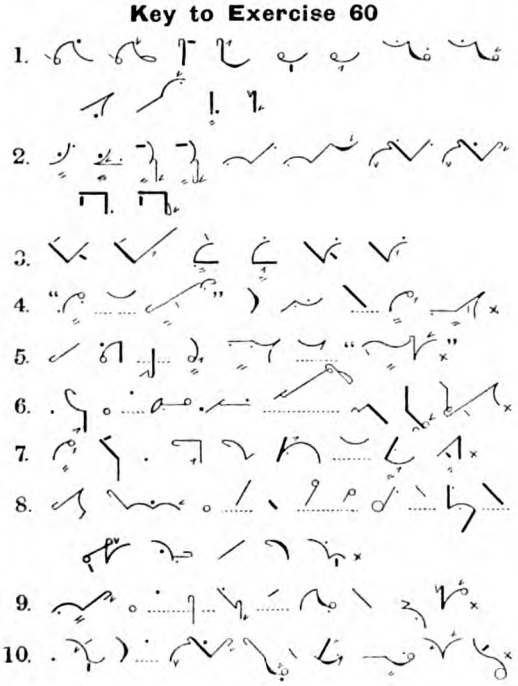
F. H.

SHORTHAND.—XVII

Key to Exercise 59

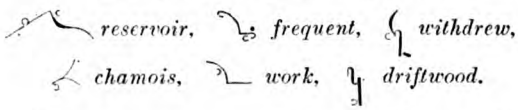
1. crayon, bayonet, real, really, industrious, envious, carrying, hurrying.
2. blower, drawer, brewer, brewery, player, theory, snowy, truant, Genoa.
3. *The* theory *of-the* Professor *with* regard *to-the* geographical features *of-the* Norwegian territory *is* full *of* new ideas.
4. *We-shall-have to-*reinvest *our* money *in-the* petroleum shares.
5. *The* easiest *way to* approach *the* Italian astronomer *is-to-*seek-*the* assistance *of Mr.* Lowell.
6. *Our* crayons *have-been much* appreciated wherever *they-have-been* used *in schools and* colleges.
7. *We* regret *to-*state *that* Georgia Elliott *is* suffering *from an* attack *of* pneumonia.
8. *In* obedience *to-the* orders *of-my doctor, I-*am journeying *to* Borneo *and* Samoa.
9. *When I* get *to-the* latter place *I-*hope *to-*make *an* acquaintance *with-the* places *and people* associated *with-the* name *of* Robert Louis Stevenson.
10. *It-is* unfortunate *that-the* Dieppe shares *have* depreciated *in-*value, *but you* were *too* ready *to-*reinvest *your* money.
11. *The* pianist *gave a* brilliant rendering *of* various classical pieces, *which-was much* appreciated *by-the* audience.
12. *The* librarian *has often remarked that-the* demand *for-the* books *of-the* various poets is-now *much-more* brisk than *in* previous *years*, a tendency *on the* part *of* borrowers *which has given him much-pleasure.*

Key to Exercise 60



W and Y Diphthongs.—The signs ‹ › written in the vowel-places, are used to represent the diphthong formed by *w* followed by any vowel; thus –

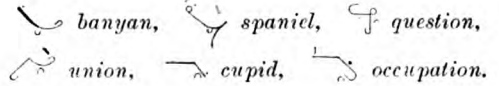
wah or *wă*	‹ ›	*waw* or *wŏ*
wā ,, *wĕ*	‹ ›	*wō* ,, *wŭ*
wēē ,, *wĭ*	‹ ›	*wōō* ,, *wŏŏ.*



reservoir, frequent, withdrew, chamois, work, driftwood.

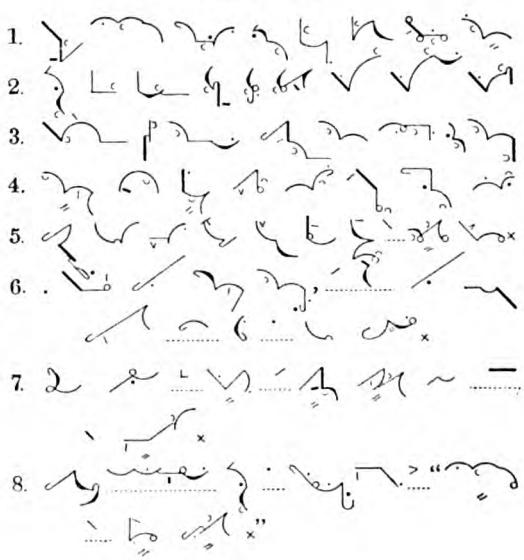
The signs ◡ ◠, written in the vowel-places, are used to represent the diphthong formed by *y* (*or ĭ*) followed by any vowel; thus—

yah or *yă*	◡ ◠	*yaw* or *yŏ*
yā ,, *yĕ*	◡ ◠	*yō* ,, *yŭ*
yēē ,, *yĭ*	◡ ◠	*yōō* ,, *yŏŏ.*



banyan, spaniel, question, union, cupid, occupation.

Exercise 61

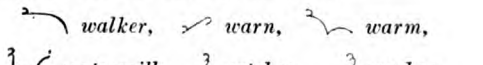


Key to Exercise 61

1. boudoir, memoir, frequently, hardware, twenty, twelve, subsequence, Wareham.
2. herewith, tweak, twinkle, withdrew, withstand, withhold, bewilder, bewildering, bewildered.
3. bulwark, twaddle, working, woodwork, worm, misquoted, eastward, wormwood.
4. Yarmouth, lawyer, Daniel, righteous, million, obtuse, creature, emulate.
5. *We-shall-be-*pleased *if-you-will* kindly forward five dozen volumes *of* Wordsworth's poems.

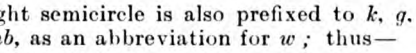
6. *The* books were *very*-much worm-eaten, *and although* rare *could-not-be* worth *more* than *a* few shillings.
7. *There-is-no* reason *why* Percy *and* Rudyard Rushworth *should-not go to* Cornwall.
8. *We-have-pleasure in*-enclosing herewith *a* presentation copy *of-the* "Memoirs *of* Thomas Wentworth."

Joined Signs.—The right semicircle for *waw* or *wŏ* may be joined to *k*, *r* (upward and downward), *tr*, *chr*, *shr*, *m*, *mp*, *mb* as in—



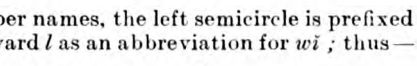
walker, *warn*, *warm*, *watermill*, *watcher*, *washer*.

The right semicircle is also prefixed to *k*, *g*, *m*, *mp*, *mb*, as an abbreviation for *w*; thus—



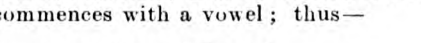
wake, *wig*, *women*.

In proper names, the left semicircle is prefixed to downward *l* as an abbreviation for *wĭ*; thus—



Willman, *Wilkins*.

The joined initial semicircle is always read first, so that the stroke *w* must be written when a word commences with a vowel; thus—



wake, *awake*.

Diphones and W and Y Diphthongs.—The following points relating to the diphones and the *w* and *y* diphthongs should be carefully noted—

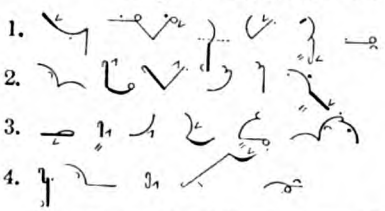
1. The diphones are angular signs; the *w* and *y* signs are semicircular.
2. The diphones represent two consecutive vowels in two separate syllables; the *w* and *y* signs represent diphthongs.
3. The diphones are never joined; the *w* and *y* signs may be joined.
4. The diphones represent any two consecutive vowels; the *w* and *y* signs represent *w* or *y* (or *ĭ*) and any vowel.
5. The diphones are used in the representation of a majority of words containing two consecutive vowels; the *w* signs are fairly largely used, the *y* signs mostly limited to the sounds of *ŭ* or *yŭ*.

By way of revision and practice in the use of Diphones and Diphthongs, the student should write in shorthand the following short exercise, afterwards checking from the key given below.

Exercise 62

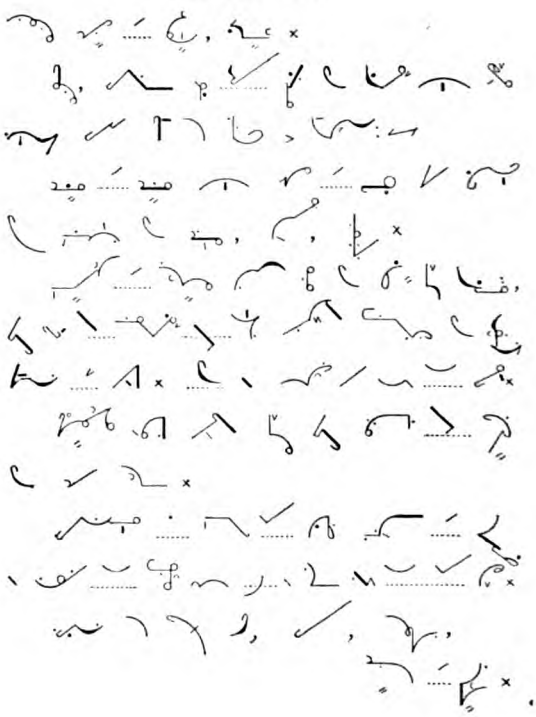
1. Bayonet, experience, sea-weed, theory, Austrian, accuse.
2. Worm, drawings, brewery, washer, water, Arabia.
3. Gayest, Druid, showy, saying, Wilkins, millionaire.
4. Driftwood, work, truant, worrying, misyoked.

Key to Exercise 62.



The keys to the following two Exercises will be given in next Lesson.

Exercise 63



Exercise 64

James Cromwell & Sons,
Wakefield.

Gentlemen,

Our Model Wagon embodies *the improvements suggested by-the* experience *of over* twelve *years, and* ensures economy *in* fuel *and* water.

At-the recent show held *at* Union Avenue, Ardwick, *we*-were awarded *the* Premier Prize.

Messrs. Wimpole & Walmsley *of-your* town *have* used *these* wagons *for-several years and-would-be*-pleased *to-give-you any information you-may*-require.

Please-note *that-these* Model Wagons *are* made only *at our* Warrington works.

Yours-truly,
Daniel Eastwood & Sons.

Continued from Vol. IV., page 443.

ENGLISH LANGUAGE AND LITERATURE:

Contributors:—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY (E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

THE NOVEL.—V

THE most remarkable period in the whole story of English fiction, not excluding even the era when Richardson, Fielding and Smollett were introducing the modern novel, or the years when Scott and Jane Austen reached the zenith of their powers, occurred between 1847 and 1859.

Some Great Novelists

During these twelve years Dickens and Thackeray were writing their masterpieces, and Lytton his domestic series. In 1847 Charlotte Brontë arose as a star of intensest brightness with her *Jane Eyre*, and was joined next year by her sister Emily with *Wuthering Heights*. Charles Kingsley sprang into the arena of social controversy in 1850 with *Alton Locke*.

In the same year Hawthorne published *The Scarlet Letter*, and *The House with the Seven Gables* two years later, simultaneously with Mrs. Harriet Beecher Stowe's *Uncle Tom's Cabin*. Mrs. Gaskell's *Cranford* appeared in 1853. Anthony Trollope began his Barsetshire series with *The Warden* in 1855. Next year came Charles Reade's powerful, and perhaps most popular, story *It is Never Too Late to Mend*. The year after, "George Eliot" published her *Scenes from Clerical Life*, and in 1859 her *Adam Bede* was contemporaneous with the first draft of George Meredith's *Ordeal of Richard Feverel*.

In that dozen years at least ten novelists were writing for posterity.

Charlotte Brontë, born in Yorkshire in 1816 of Irish parentage, spent her life either in her father's modest parsonage at Haworth, on the edge of the Yorkshire moors, or as a school-mistress, privately in England or in Brussels, as pictured in *Villette*. Her sisters Emily (1818-1848) and Anne (1820-1849) tried the same life as teachers, but for it they were less fitted.

From childhood writing was their romantic diversion. The family was completed by an austere father and a ne'er-do-well brother. Their chief friends were Yorkshire manufacturers of the type pictured in Charlotte's story *Shirley*. Very largely their own characters were shaped by the tragedy of their ruined brother and the wide loneliness of the stern moorlands. No other writers of our tongue have expressed such an intensity of passion in fiction as Charlotte Brontë in *Jane Eyre* and Emily Brontë in *Wuthering Heights*. They lay bare the very souls of men and women, with nature framed into a background that blends with the human action.

Charlotte had the broader, more practical, and more artistic mind; but Emily had imperious, if narrower, strength, and, further, was a true poet. Her *Wuthering Heights* is formless and gloomy and yet fascinates.

The Brontë Sisters

A whole library has been written about these remarkable and sad-fated women, the first place on its shelves being taken by Mrs. Gaskell's sympathetic and classical *Life*. The essential work of the sisters is contained in *Jane Eyre*, *Villette*, *Shirley*, *Wuthering Heights* and Emily Brontë's poems. Anne's *Tenant of Wildfell Hall* and *Agnes Grey* have less strength. Among all English novels *Jane Eyre* is pre-eminent as coming straight from the heart, with a sense of poignant reality. It was an immediate success, and altered the whole complexion of the family life. Charlotte Brontë died in 1855, a year after marrying her father's curate.

Charles Kingsley, son of a Devonshire

clergyman, was born in 1819. A manly ardour permeated his life. On leaving Cambridge and entering the Church he was drawn to the "Broad" movement, and preached what was called "Christian Socialism" so strongly that he was barred from London pulpits by the bishop. In his later years he drew crowds to the Abbey as Canon of Westminster. A poet, pamphleteer, writer of popular science, and some history when he was Professor of Modern History at Cambridge, he will be remembered for his open, breezy character and four novels.

These are *Alton Locke*, dealing with urban social conditions, *Hypatia*, a careful study of Alexandrian history, *Westward Ho!* a vigorous tale of Elizabethan adventure written with an attractive gusto, and *Hereward the Wake* (1866), an historical sketch of the early romance of the fenlands, a region he knew well.

While Kingsley's writings never disclosed a defined and consistent aim, and were wanting in depth, they were earnest, vigorous, and manly, and appeal healthily to the romantic temperament. Kingsley died in 1875, and has been commemorated in an attractive Memoir by his wife.

Anthony Trollope

Anthony Trollope, popular as a novelist during his life, suffered a temporary eclipse after his death, partly owing to the self-depreciatory candour of his *Autobiography* (1883), but, half a century having passed since, his Barsetshire cycle of novels was completed, the conviction has returned that in Trollope the social history of the mid-nineteenth century, in rural England, has invaluable illustrations. The series consists of *The Warden* (1855), *Barchester Towers* (1857), *Dr. Thorne* (1858), *Framley Parsonage* (1861), *The Small House at Allington* (1864), and *The Last Chronicle of Barset* (1867).

Trollope was born in London in 1815. His father was a headstrong barrister who began to prosper but persistently offended his clients, and then ruined himself by speculation. Mrs. Trollope afterwards supported her family and husband by writing a hundred novels and some books of travel. As a youth Anthony entered the Post Office, and at the age of 26 was sent to superintend postal affairs in a remote Irish district. Here he was suited by an open-air life and became a successful official. He began to hunt and to write, his first novel being published when he was 32.

On being removed to the west of England he published, at the age of 40, his first Barsetshire novel, with Winchester as its scene. Hitherto his books had failed. Now he gradually became popular and amassed a fortune by his writings. After retiring from the Post Office service at the age of 51, Trollope lived in London and wrote political novels, beginning with *Phineas Finn* (1869). He always wrote about the life by which he was surrounded. It is the West-country series (1855 to 1867) that are the foundation of his fame, as they were of his fortune.

Trollope's account of his writing in his *Autobiography*, published after his death, is cynically disparaging, and too often he has been judged by it. It is true that he wrote with slap-dash haste, without an exalted ideal, or any theory of psychological analysis; but he gave faithful pictures of the life around him, with clear definition of character in both men and women, and he has the power of telling a tale that moves on continually at a pace that is both pleasing and restful. His Barsetshire series of naturally told tales are historical miniatures of provincial life attractive alike to the student and the man who reads for pleasure.

George Eliot

"George Eliot," whose maiden name was Mary Ann Evans, and her married name Mrs. Cross, was the only Englishwoman who as a writer has annexed and held, not unsuitably, a man's name. She was born near Nuneaton in 1819, her father being a land agent, the original of Caleb Garth in *Middlemarch*. In her thirty-second year, after the death of her father, she became assistant-editor of the *Westminster Review*.

In 1857 she "found herself" by writing short stories for *Blackwood's Magazine*, published next year as *Scenes from Clerical Life*. *Adam Bede* (1859) placed her in the first rank of novelists. Her other stories were *The Mill on the Floss* (1860), *Silas Marner* (1861), *Romola* (1862-1863), *Felix Holt, the Radical* (1866), *Middlemarch* (1871-72), and *Daniel Deronda* (1874-76), the last two being issued in monthly parts. She also published two volumes of poems, and a heavy book of sententious sayings. Before attempting fiction she had been engaged in translating German theology. In the last year of her life (1880) she married Mr. John Cross, who became her biographer.

As a depicter of English rural life, and the types of middle-class and working-class character it produces, George Eliot stands easily at the head of English novelists. She covers a far wider range than either

Jane Austen, Charlotte Brontë, or Anthony Trollope, and is only approached, *par excellence*, by Thomas Hardy. At her best she is less consciously literary than either Thackeray or Dickens, and compares with the most spontaneous parts of Scott. Like him she can reflect the life she knows with the most complete fidelity and naturalness.

But unfortunately she was prone to philosophising, and that mood gave her writing a stilted air. While she was content to mirror the simplicities of life, and the humour and pathos with which they are charged, she was inimitable; when her wide knowledge, particularly of science, came into play, or she set herself the task of a formal study, she loaded her books with reflection in language that is not the language of tale-telling. And this encumbrance grew with her years. It waterlogged *Daniel Deronda* unless we regard it as a study of a problem rather than as a story.

From the drawing by Frederick W. Burton, F.S.A., in the National Portrait Gallery: by permission of Henry B. Burton, Esq.

"GEORGE ELIOT" (1819-1880),

the only Englishwoman who as a writer has annexed and held, not unsuitably, a man's name. Her maiden name was Mary Ann Evans.

George Eliot is near her best almost continuously in *Adam Bede;* throughout *Silas Marner*, one of the gems of British fiction; in early scenes of *The Mill on the Floss;* in some chapters of *Felix Holt*—a book with an unconvincing plot; and in many of the conversational parts of *Middlemarch*—a broad canvas, but too exclusively illustrating incompatibility in marriage.

The writing of *Romola* was the turning point for the worse in its author's aims. She turned from the life she knew with a rare fidelity, and attempted a great study amid impressive historical surroundings. Her industry and care were severe. It is a brilliant effort; but it is too palpably an effort.

From a sketch by G. Richmond.

CHARLOTTE BRONTË (1816–55),

author of *Shirley* and *Jane Eyre*, the eldest and best known of the three brilliant Brontë sisters.

George Eliot was a great novelist, and no other writers except Scott and Dickens have brought so many permanent characters into the world of fiction.

Since George Eliot's day the English novelists who may be accepted as already classical are George Meredith and Thomas Hardy, who reached their zenith as writers, if not in popularity, in the seventies of the nineteenth century, and Robert Louis Stevenson, whose best work was written in the eighties.

About George Meredith (1828-1909) more criticism has been written than about any other modern writer. The reason is that he is the literary man's novelist. His condensed thought, his wit and epigram, and his subtle analyses of character, appeal

strongly to those who are more concerned with literary expression than with the general flow of a story. But his curiously-packed sentences are often conundrums with doubtful answers. The reading of much of Meredith's work is an intellectual exercise from which the average mind will shrink.

Richard Feverel (1859), *Rhoda Fleming* (1865), *The Egoist* (1879), and *Diana of the Crossways* (1885) are his best known and most easily followed stories. Of these *The Egoist* is the one which will surely preserve his name in English literature. In it he puts self-complacent all-demanding pride under the microscope and scans it with an unmerciful clearness of vision. Finely consistent character studies abound. The tale coheres closely around Sir Willoughby Patterne ; its women are superbly drawn, and it is brightened by the best-sketched boy in English literature.

Why a brilliant man, a judge of books, for Meredith was during many years a publisher's adviser, should write as in *The Egoist* and then write as he did in other of his books is a mystery.

Thomas Hardy

Thomas Hardy, born in 1840, in his youth an architect, lived after becoming a novelist in Dorchester, and made Wessex as surely known through our latest English literature as it is known through our earliest English history.

From poetry he turned to prose fiction, but reverted seriously to poetry as the intellectual outlet of his maturest years, and entered a strong claim to be regarded, by reason of *The Dynasts*, as the most considerable poet of the early twentieth century.

Hardy became famous through his *Far from the Madding Crowd*, published in 1874 ; but two years earlier he had deserved joyful recognition in the brightest of his books, *Under the Greenwood Tree*. Among his other stories the most distinctive are *The Return of the Native* (1878), *The Mayor of Casterbridge* (1884-85), *The Woodlanders* (1886-87), *Tess of the D'Urbervilles* (1891), and *Jude the Obscure* (1895). His mastery of the short story is proved in *Wessex Tales* (1888) and *Life's Little Ironies* (1894).

Hardy's studies of country life and character challenge comparison with the best work of George Eliot in the same field. They bear the same impress of intense reality. Rustic life is pictured with fidelity, but, except perhaps in Gabriel Oak in *Far from the Madding Crowd*, with the omission of the noble forms of simplicity which may be found, not as a rarity, in every country side.

In a remarkable degree Hardy blends human character with its scenic surroundings. Nature is not a background merely ; his people are a part of it. They tone with his dark heaths and his grazing downs, like the animals that home there under the changing year. Though his books abound in humour their mental atmosphere is sombre on the whole. As if a thunderstorm were beginning to gather on the horizon, there is a feeling in the air of impending and inexorable fate, which moulds human destiny in spite of the protesting will. A great and powerful writer, Hardy is not really cheered by life's comedy, nor is he sustained by any exalted hopes.

Robert Louis Stevenson

Robert Louis Stevenson, the most choice of modern Scottish writers, was much more than a novelist. He was a genuine poet of nature and of child-life, an exquisite essayist, a skilful writer of short stories, especially stories with a touch of diablerie in them, besides being a delightful writer of romantic adventure. In Stevenson, as in his Scottish contemporary Barrie, the sense of charm in style was highly developed. Born in 1850, the son of a lighthouse builder, he spent his life in wanderings in search of health, into England to Bournemouth, into Switzerland to Davos, to California, and finally to the Samoan islands, where he died in 1894, and is buried on a tree-clad hill.

Stevenson's most characteristic travel books were published in the late seventies—*An Inland Voyage*, in 1878, and *Travels with a Donkey in the Cevennes*, in 1879 ; his essays in the early eighties—*Virginibus Puerisque*, 1881 ; *Familiar Studies of Men and Books*, 1882 ; *Memories and Portraits*, 1887 ; and *Vailima Letters*, 1895.

His ever popular *A Child's Garden of Verse* (1885), and *Underwoods* (1887), were followed by occasional verse during later years. *Treasure Island*, now a boys' classic, was published serially in 1881. With *Dr. Jekyll and Mr. Hyde*, a sensational story of dual personality, Stevenson first attained wide popularity. *Kidnapped*, and its sequel *Catriona*, with *The Master of Ballantrae* make the staple of Stevenson's longer novels. *St. Ives* was left unfinished and was completed by Mr. (now Sir Arthur) Quiller Couch. A striking fragment, *Weir of Hermiston*, was published after its author's death. Several plays, written with W. E. Henley, were not stage successes.

Stevenson's sketches of Scottish character, blending with a narrative of adventure, approach closely the naturalness of Scott, though the style is studiously sustained, while the older master wrote "right off." *Catriona* falsifies the criticism of failure in depicting women. The posthumous fragment *Weir of Hermiston* suggests strongly that the novelist's best work would have come in later years.

VAILIMA LETTERS.

A striking portrait of Robert Louis Stevenson dictating to Mrs. Isobel Strong, his stepdaughter and amanuensis.

The reader of Stevenson not only comes into touch with a stylist of rarest delicacy and haunting charm but also with a personality instinct with poetry and a pathetic courage.

To each of the more prominent of novelists not commented on hitherto only a passing glance can be given here. Mention may be made of the rollicking Irish stories of Charles Lever (1806-1872), which Irishmen disclaim as representative of the national temperament; and the sporting novels of G. J. Whyte-Melville, that opened up a new field for fiction. A novel that holds, and is likely to hold, a foremost place in English fiction is the *Lorna Doone* (1869) of Richard Doddridge Blackmore, an idyllic Exmoor love-story with an historical tinge. *Lorna Doone* is an instance of a clever author transcending himself once and touching genius.

In the 'seventies of the nineteenth century William Black (1841-1898), a journalist with an artistic appreciation of nature, became popular with *A Daughter of Heth* (1871), a picture of a vivacious French girl in the midst of Scottish restraint; and he confirmed his success with *A Princess of Thule* (1873), a Hebridean tale. Black wrote with grace and sympathy within a restricted range.

At the same time Walter Besant (1836-1901), in collaboration with James Rice (1844-1882), wrote vigorous stories, breezy and humorous — *Ready-money Mortiboy* (1872), and *The Golden Butterfly* (1876). After the death of Rice, Besant continued his tales, with less vigour but more literary delicacy, in *Dorothy Forster* (1884), an historical study of considerable distinction, and *Children of Gibeon* (1886), a picture of social conditions in the East End. Besant,

a man of fine character, greatly respected in literary circles, wrote, besides novels, valuable historical studies of London. He was knighted in 1895.

Before the close of the 'seventies three American novelists had gained a hold on the English-speaking public, Samuel Langhorne Clemens (1835-1910), who, writing under the pseudonym of Mark Twain, had published his *Tom Sawyer* (1876), after leaping into popularity with his humorous travel sketches *The Innocents Abroad* (1869); Bret Harte (1839-1902), a writer of powerful short stories of Californian mining life; and Henry James (1843-1916), whose *Daisy Miller* (1878) attracted attention by its delicate analysis of character, and who continued his psychological dissection of personality in many stories through the following thirty years.

Modern Novelists

Of the novelists who became popular during the last twenty years of the century only passing mention can be made. Joseph Henry Shorthouse (1834-1903), scored a success with *John Inglesant*, a religious story of the quietest order, written with thoughtful finish. Robert Buchanan (1841-1901), a prolific poet and occasionally successful dramatist, embodied a protest against war in a powerful story *God and the Man*. William Hale White (1831-1913), in *The Autobiography of Mark Rutherford*, toned his story to the atmosphere of religious doubt. Sir Henry Rider Haggard (born 1856) found scope in Africa for vigorous romance merging into melodrama.

Sir James Matthew Barrie (born 1860) combined humour, pathos, and elfish imagination in sketches of Scottish character, notably *A Window in Thrums*, and repeated his success in graceful comedies artistic in texture. Sir Arthur Quiller Couch (born 1863) worked the veins of Stevensonian romance and Cornish humour, and attained a fine mastery of the short story. George Gissing (1857-1903), gloomily coloured by his surroundings, pictured grimly the nether world of literary London, but emerged finally into a thoughtful gentleness in his *Private Papers of Henry Ryecroft*.

Olive Schreiner, a Cape lady, reached a high intensity in her *Story of an African Farm*. Miss Marie Corelli secured large circulations by romances written in a strain of exuberant rhetoric. Hall Caine (born 1853), an accomplished literary stage manager, gave a new interest to the Isle of Man by his popular stories. Sir Arthur Conan Doyle (born 1859), a doctor, robust in mind and personality, succeeded equally in historical romance, in ingenious detective mysteries, and, outside fiction, in masculine surveys of military operations. Stanley John Weyman (born 1855), in his semi-historical tales, showed rare constructional skill, constant evolution of character and movement in narrative, free from all redundancies. Sir Anthony Hope Hawkins (born 1863), a master of the dialogue that reveals the lighter shadings of character, combined in his stories romance with clear-cut portraiture. Hugh Stowell Scott (1863-1903), whose pen-name was Henry Seton Merriman, came into prominence with his strong Russian story *The Sowers*, and sustained his reputation with his French character study *Barlasch of the Guard*. Mrs. Humphry Ward (1851-1920), the most substantial woman novelist of the period, introduced religious, social, and political problems into her earlier books, and gained in lightness and movement as she became less ambitiously reflective.

Rudyard Kipling

Rudyard Kipling (born 1865), the most popular poet of his generation, opened out new vistas to imagination in his *Jungle Books* and other children's stories. In the short story he often reaches astonishing power, but is strangely uneven. No other work of fiction approaches his longer masterpiece *Kim*, as an interpretation of the life of the East.

The success of Barrie in bringing up to date the portrayal of Scottish character brought two ministers into the field of fiction, the Rev. John Watson (1850-1907), writing, as "Ian Maclaren," sketches from the pastoral point of view strongly charged with pathos; and the Rev. Samuel Rutherford Crockett (1860-1914), who turned almost at once from the humours of the Kirk to romance centring on the Galloway region. Crockett had the gift of picturesque narrative but outworked his material. Gaelic Scotland was represented in the poetically attuned romances of William Sharp (1856-1905) writing as "Fiona Macleod," and in a masculine vein by the strong well-balanced tales of Neil Munro (born 1864).

Among novelists whose writing claimed critical consideration shortly before the close of the century were Maurice Hewlett (born 1861), a man of poetic mould who went back to the days of chivalry in his *Forest Lovers;* Israel Zangwill (born 1864), a humorist, essayist and dramatist who has striven to re-interpret the Jewish

Photo: E. O. Hoppé.

RUDYARD KIPLING
(born 1865).

Photo: G. C. Beresford.

SIR JAMES BARRIE, BART.
(born 1860).

Photo: E. O. Hoppé.

HENRY JAMES
(1843-1916).

race; Sir Gilbert Parker (born 1862), whose vigorous romances are based largely on Canadian history; Richard Whiteing, a veteran journalist, who in his sixtieth year made a great success with his study of London life *No. 5 John Street;* Joseph Conrad, a Polish sea-captain who adopted English as his literary language and whose powerful stories centre chiefly on the South Seas; Eden Phillpotts (born 1862) who, in sombre power, is the Hardy of Devonshire; Enoch Arnold Bennett, a versatile writer, conspicuous in candour, who introduced the drab life of the Potteries to the world; and Herbert George Wells (born 1866) who began with stories based on science, passed on to socialistic and political questions, and remains one of the most vigorous minds of the time seeking settled ground.

In the two decades which opened the twentieth century the output of fiction, in the English-speaking world, became amazingly large, invading even the popular newspaper press. The novel covered the whole range of human life and character, and its writers were numbered by the thousand, but, broadly surveyed, though, after Meredith and Hardy, a high general level of literary technique was often reached, British fiction lacked the unmistakable genius which leaves conspicuous landmarks along the centuries.

J. D.

Photo: E. O. Hoppé.

ARNOLD BENNETT
(born 1867).

Photo: G. C. Beresford.

JOSEPH CONRAD
(born 1857).

Photo: E. O. Hoppé.

H. G. WELLS
(born 1866).

Drawn by R. Caton Woodville.

THE COLDSTREAM GUARDS

reviewed by Charles II. at Blackheath. It was on this occasion that the King gave the name "My Coldstream Guards" to the regiment which, in January, 1660, had marched with Monk from Coldstream, in Berwickshire, to London, to secure a "Free Parliament." Note the manner of standing at attention: legs apart, the musket "ported" for the salute.

Continued from Vol. IV., page 452.

HISTORY:

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BRITAIN'S STORY.—XVI

[*The introductory chapter to* LORD MACAULAY'S "*History of England*" *has been adopted in this work to explain the development of the British race prior to* 1660. *But as Lord Macaulay's work was intended merely as a sketch, explanatory passages (printed in closer type) have been interpolated in order to meet the requirements of the student.*]

CROMWELL seems to have wished to govern constitutionally, and to substitute the empire of the laws for that of the sword. But he soon found that, hated as he was, both by Royalists and Presbyterians, he could be safe only by being absolute. The first House of Commons which the people elected by his command, questioned his authority, and was dissolved without having passed a single act. His second House of Commons, though it recognised him as Protector, and would gladly have made him King, obstinately refused to acknowledge his new Lords. He had no course left but to dissolve the Parliament. "God," he exclaimed, at parting, "be judge between you and me!"

Cromwell's Constitutional Experiments

Yet was the energy of the Protector's administration in nowise relaxed by these dissensions. Those soldiers who would not suffer him to assume the kingly title stood by him when he ventured on acts of power, as high as any English King has ever attempted. The government, therefore, though in form a republic, was in truth a despotism, moderated only by the wisdom, the sobriety, and the magnanimity of the despot. The country was divided into military districts. Those districts were placed under the command of Major-Generals.

Every insurrectionary movement was promptly put down and punished. The fear inspired by the power of the sword, in so strong, steady, and expert a hand, quelled the spirit both of Cavaliers and Levellers. The loyal gentry declared that they were still as ready as ever to risk their lives for the old government and the old dynasty, if there were the slightest hope of success: but to rush, at the head of their serving men and tenants, on the pikes of brigades victorious in a hundred battles and sieges, would be a frantic waste of innocent and honourable blood. Both Royalists and Republicans, having no hope in open resistance, began to revolve dark schemes of assassination: but the Protector's intelligence was good: his vigilance was unremitting; and, whenever he moved beyond the walls of his palace, the drawn swords and cuirasses of his trusty bodyguards encompassed him thick on every side.

Taxation and Toleration

Had he been a cruel, licentious, and rapacious prince, the nation might have found courage in despair, and might have made a convulsive effort to free itself from military domination. But the grievances which the country suffered, though such as excited serious discontent, were by no means such as impel great masses of men to stake their lives, their fortunes, and the welfare of their families against fearful odds.

The taxation, though heavier than it had been under the Stuarts, was not heavy when compared with that of the neighbouring states and with the resources of England. Property was secure. Even the Cavalier, who refrained from giving disturbance to the new settlement, enjoyed in peace whatever the civil troubles had left him. The laws were violated only in cases where the safety of the Protector's person and government was concerned. Justice was administered between man and man with an exactness and purity not before known.

Under no English government since the Reformation had there been so little religious persecution. The Protector's foreign policy at the same time extorted the ungracious

approbation of those who most detested him. The Cavaliers could scarcely refrain from wishing that one who had done so much to raise the fame of the nation had been a legitimate King; and the Republicans were forced to own that the tyrant suffered none but himself to wrong his country, and that, if he had robbed her of liberty, he had at least given her glory in exchange.

A Great Leader

After half a century during which England had been of scarcely more weight in European politics than Venice or Saxony, she at once became the most formidable power in the world, dictated terms of peace to the United Provinces, avenged the common injuries of Christendom on the pirates of Barbary, vanquished the Spaniards by land and sea, seized Jamaica, one of the finest West Indian islands, and by taking Dunkirk, acquired on the Flemish coast a fortress which consoled the national pride for the loss of Calais.

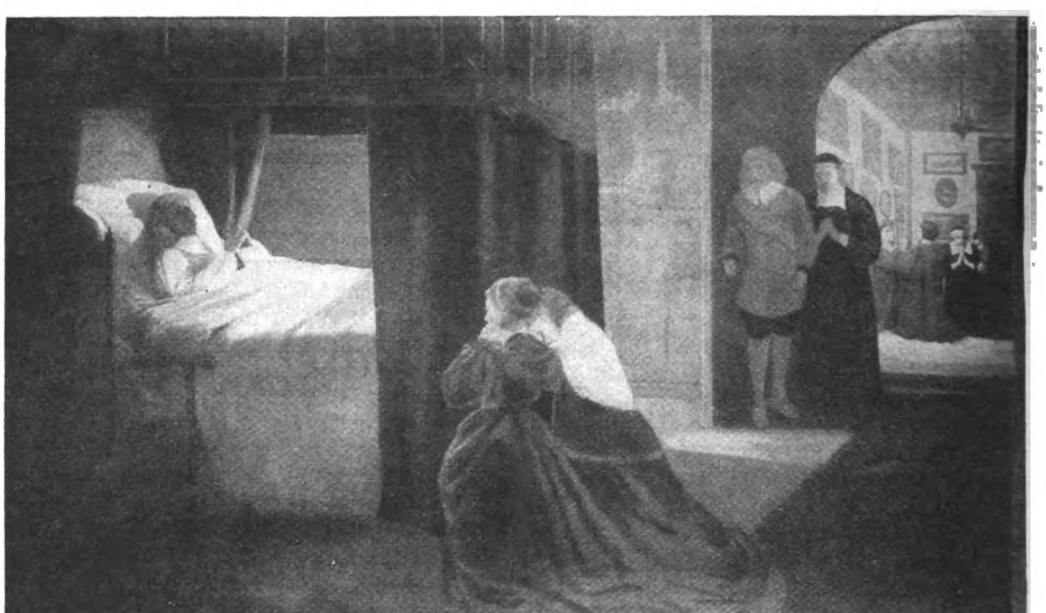
She was supreme on the ocean. She was the head of the Protestant interest. All the reformed Churches scattered over Roman Catholic kingdoms acknowledged Cromwell as their guardian. Even the Pope was forced to preach humanity and moderation to Popish princes. For a voice which seldom threatened in vain had declared that, unless favour were shown to the people of God, the English guns should be heard in the Castle of Saint Angelo.

It has often been affirmed, but with little reason, that Oliver died (Sept. 3, 1658) at a time fortunate for his renown, and that, if his life had been prolonged, it would probably have closed amidst disgraces and disasters. It is certain that he was, to the last, honoured by his soldiers, obeyed by the whole population of the British islands, and dreaded by all foreign powers, that he was laid among the ancient sovereigns of England with funeral pomp such as London had never before seen, and that he was succeeded by his son Richard as quietly as any King had ever been succeeded by any Prince of Wales.

Richard Cromwell

During five months, the administration of Richard Cromwell went on so tranquilly and regularly that all Europe believed him to be firmly established on the chair of state.

For a time it seemed highly probable that he would, under the direction of able advisers, effect what his father had attempted in vain. A Parliament was called, and the writs were directed after the old fashion. The small boroughs which had recently been disfran-



From the picture by D. Wynfield, in the S. Kensington Museum.

THE DEATH OF CROMWELL.

Taken ill while at Hampton Court in 1658, the Protector at once returned to Whitehall, where he died on his "lucky" day, September 3, the anniversary of his victories at Worcester and Dunbar. He was 59 years of age at the time of his death, and was buried with great pomp in Westminster Abbey. At the Restoration his remains were disinterred, the body being buried elsewhere.

chised regained their lost privilege: Manchester, Leeds, and Halifax ceased to return members; and the county of York was again limited to two knights.

It may seem strange to a generation which has been excited almost to madness by the question of parliamentary reform that great shires and towns should have submitted with patience, and even with complacency, to this change: but though speculative men might, even in that age, discern the vices of the old representative system, and predict that those vices would, sooner or later, produce serious practical evil, the practical evil had not yet been felt.

Oliver's representative system, on the other hand, though constructed on sound principles, was not popular. Both the events in which it originated, and the effects which it had produced, prejudiced men against it. It had sprung from military violence. It had been fruitful of nothing but disputes. The whole nation was sick of government by the sword, and pined for government by the law. The restoration, therefore, even of anomalies and abuses, which were in strict conformity with the law, and which had been destroyed by the sword, gave general satisfaction.

Among the Commons there was a strong opposition, consisting partly of avowed Republicans, and partly of concealed Royalists: but a large and steady majority

From the fresco by E. M. Ward, R.A., in the Palace of Westminster. Photo: Emery Walker, Ltd.

MONK DECLARING FOR A FREE PARLIAMENT.

Dissatisfied with the state of affairs in England, General George Monk (later Duke of Albemarle), who then held the Scottish command, crossed the Border on Jan. 1, 1660, and advanced at the head of his army on London. Opposition proved fruitless; the Rump (i.e. the remnant of the old Long Parliament) welcomed him as a deliverer and gladly allowed its own dissolution. Monk then called for a free and newly elected Parliament and so paved the way for the restoration of the Monarchy.

appeared to be favourable to the plan of reviving the old civil constitution under a new dynasty. Richard was solemnly recognised as first magistrate. The Commons not only consented to transact business with Oliver's Lords, but passed a vote acknowledging the right of those nobles who had, in the late troubles, taken the side of public liberty, to sit in the Upper House of Parliament without any new creation.

Thus far the statesmen by whose advice Richard acted had been successful. Almost all the parts of the government were now constituted as they had been constituted at the commencement of the civil war. Had the Protector and the Parliament been suffered to proceed undisturbed, there can be little doubt that an order of things similar to that which was afterwards established under the House of Hanover would have been established under the House of Cromwell.

But there was in the state a power more than sufficient to deal with Protector and Parliament together.

Military Rule

On the very day of Richard's accession the officers began to conspire against their new master. The good understanding which existed between him and his Parliament hastened the crisis. Alarm and resentment spread through the camp. Both the religious and the professional feelings of the army were deeply wounded. It seemed that the Independents were to be subjected to the Presbyterians, and that the men of the sword were to be subjected to the men of the gown. A coalition was formed between the military malcontents and the republican minority of the House of Commons.

It may well be doubted whether Richard could have triumphed over that coalition, even if he had inherited his father's clear judgment and iron courage. It is certain that simplicity and meekness like his were not the qualities which the conjuncture required. He fell ingloriously (May, 1659) and without a struggle. He was used by the army as an instrument for the purpose of dissolving the Parliament, and was then contemptuously thrown aside.

The officers gratified their republican allies by declaring that the expulsion of the Rump had been illegal, and by inviting that assembly to resume its functions. The old Speaker and a quorum of the old members came together, and were proclaimed, amidst the scarcely stifled derision and execration of the whole nation, the supreme power in the commonwealth. It was at the same time expressly declared that there should be no first magistrate, and no House of Lords.

This state of things, however, could not last.

On the day on which the Long Parliament revived, revived also its old quarrel with the army. Again the Rump forgot that it owed its existence to the pleasure of the soldiers, and began to treat them as subjects. Again the doors of the House of Commons were closed by military violence; and a provisional government, named by the officers, assumed the direction of affairs.

Meanwhile the sense of great evils, and the strong apprehension of still greater evils close at hand, had at length produced an alliance between the Cavaliers and the Presbyterians. Some Presbyterians had, indeed, been disposed to such an alliance even before the death of Charles I.: but it was not till after the fall of Richard Cromwell that the whole party became eager for the restoration of the royal house.

There was no longer any reasonable hope that the old constitution could be re-established under a new dynasty. One choice only was left, the Stuarts or the army. The banished family had committed great faults; but it had dearly expiated those faults, and had undergone a long, and, it might be hoped, a salutary training in the school of adversity. It was probable that Charles II. would take warning by the fate of Charles I.

The Army of Scotland

But, be this as it might, the dangers which threatened the country were such that, in order to avert them, some opinions might well be compromised, and some risks might well be incurred. It seemed but too likely that England would fall under the most odious and degrading of all kinds of government, under a government uniting all the evils of despotism to all the evils of anarchy. Anything was preferable to the yoke of a succession of incapable and inglorious tyrants, raised to power, like the Deys of Barbary, by military revolutions recurring at short intervals.

If the Presbyterians obstinately stood aloof from the Royalists, the state was lost; and men might well doubt whether, by the combined exertions of Presbyterians and Royalists, it could be saved. For the dread of that invincible army was on all the inhabitants of the island; and the Cavaliers, taught by a hundred disastrous fields how little numbers can effect against discipline, were even more completely cowed than the Roundheads.

While the soldiers remained united all the plots and risings of the malcontents were ineffectual. But a few days after the second expulsion of the Rump came tidings which gladdened the hearts of all who were attached either to monarchy or to liberty. That mighty force which had, during many years, acted as one man, and which, while so acting, had been found irresistible, was at length divided against itself.

The army of Scotland had done good service to the Commonwealth, and was in the highest state of efficiency. It had borne no part in the late revolutions, and had seen them with indignation. It was intolerable that certain regiments should, merely because they happened to be quartered near Westminster, take on themselves to make and unmake several governments in the course of half a year. If it were fit that the state should be regulated by the soldiers, those soldiers who upheld the English ascendency on the north of the Tweed were as well entitled to a voice as those who garrisoned the Tower of London.

Divided Forces

There appears to have been less fanaticism among the troops stationed in Scotland than in any other part of the army; and their general, George Monk, was himself the very opposite of a zealot. He had, at the commencement of the civil war, borne arms for the King, had been made prisoner by the Roundheads, had then accepted a commission from the Parliament, and, with very slender pretensions to saintship, had raised himself to high commands by his courage and professional skill.

He had been a useful servant to both the Protectors, had quietly acquiesced when the officers at Westminster pulled down Richard and restored the Long Parliament, and would perhaps have acquiesced as quietly in the second expulsion of the Long Parliament, if the provisional government had abstained from giving him cause of offence and apprehension. For his nature was cautious and he was not at all disposed to hazard sure advantages for the chance of obtaining even the most splendid success.

He seems to have been impelled to attack the new rulers of the Commonwealth less by the hope that, if he overthrew them, he should become great, than by the fear that, if he submitted to them, he should not even be secure. Whatever were his motives, he declared himself the champion of the oppressed civil power, refused to acknowledge the usurped authority of the provisional government, and, at the head of seven thousand veterans, marched into England.

This step was the signal for a general explosion. The people everywhere refused to pay taxes. The apprentices of the City assembled by thousands and clamoured for a free Parliament. The fleet sailed up the Thames, and declared against the tyranny of the soldiers.

The soldiers, no longer under the control of one commanding mind, separated into factions. Every regiment, afraid lest it should be left alone a mark for the vengeance of the oppressed nation, hastened to make a separate peace. During thirteen years the civil power had, in every conflict, been compelled to yield to the military power. The military power now humbled itself before the civil power. The Rump, generally hated and despised, but still the only body in the country which had any show of legal authority, returned again to the house from which it had been twice ignominiously expelled.

In the meantime Monk was advancing towards London. Wherever he came, the gentry flocked round him, imploring him to use his power for the purpose of restoring peace and liberty to the distracted nation.

A Free Parliament

The General, cold-blooded, taciturn, zealous for no polity and for no religion, maintained an impenetrable reserve. What were at this time his plans, and whether he had any plan, may well be doubted. His great object, apparently, was to keep himself, as long as possible, free to choose between several lines of action.

During a short time the dissimulation or irresolution of Monk kept all parties in a state of painful suspense. At length he broke silence, and declared for a free Parliament.

As soon as his declaration was known, the whole nation was wild with delight. Wherever he appeared thousands thronged round him, shouting and blessing his name. The bells of all England rang joyously: the gutters ran with ale; and, night after night, the sky five miles round London was reddened by innumerable bonfires.

Those Presbyterian members of the House of Commons who had many years before been expelled by the army, returned to their seats, and were hailed with acclamations by great multitudes, which filled Westminster Hall and Palace Yard. The Independent leaders no longer dared to show their faces in the streets, and were scarcely safe within

their own dwellings. Temporary provision was made for the government: writs were issued for a general election; and then that memorable Parliament, which had, in the course of twenty eventful years, experienced every variety of fortune, solemnly decreed its own dissolution.

A Royalist Election

The result of the elections was such as might have been expected from the temper of the nation. The new House of Commons consisted, with few exceptions, of persons friendly to the royal family.

That there would be a restoration now seemed almost certain; but whether there would be a peaceable restoration was matter of painful doubt. The soldiers were in a gloomy and savage mood. They hated the title of King. They hated the name of Stuart. They hated Presbyterianism much, and Prelacy more. They saw with bitter indignation that the close of their long domination was approaching. But happily the dangers of a conflict were averted.

The new Parliament, which, having been called without the royal writ, is more accurately described as a Convention, met at Westminster. The Lords repaired to the hall, from which they had, during more than eleven years, been excluded by force. Both Houses instantly invited the King to return to his country.

Charles II.'s Return

He was proclaimed with pomp never before known. A gallant fleet convoyed him from Holland to the coast of Kent. When he landed, the cliffs of Dover were covered by thousands of gazers, among whom scarcely one could be found who was not weeping with delight. The journey to London was a continued triumph. The whole road from Rochester was bordered by booths and tents, and looked like an interminable fair. Everywhere flags were flying, bells and music sounding, wine and ale flowing in rivers to the health of him whose return was the return of peace, of law, and of freedom.

After the picture by Sir Benjamin West, by permission of Messrs. T. H. Parker Bros.

CHARLES II. LANDING AT DOVER, MAY, 1660,

where he was received amid scenes of extravagant enthusiasm. His journey from the coast to London was a continued triumph. Everywhere flags were flying, bells and music sounding, wine and ale flowing in rivers to the health of him whose return was the return of peace, law, and freedom.

Continued from page 19.

SCIENCES:

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MINERALOGY.—VII

IX.—SILICATES (*continued from p.* 12)

20. The Epidotes.

The classification of the epidotes is as follows:—

Name	*Composition*	*H*	*Sp. gr.*
Orthorhombic—			
Zoisite	$Ca_2(AlOH)Al_2(SiO_4)_3$	6 to 6·5	3·3
Thulite	$Ca_2(AlOH)(Al,Mn)_2(SiO_4)_3$ ..		
Monoclinic—			
Epidote .. Clinozoisite	$Ca_2(AlOH)(Al,Fe)_2(SiO_4)_3$ ..	6 to 7	3·3 to 3·5
Piedmontite Withamite	$Ca_2(AlOH)(Al,Mn,Fe)_2(SiO_4)_3$ ..	6·5	3·4
Allanite Orthite	$Ca_2(AlOH)(Al,Ce,Fe)_2(SiO_4)_3$ ..	5·5	4·0

All the epidotes crystallise in bladed prisms, rarely terminated, but usually in parallel groups or radiating bundles. There is one perfect cleavage, parallel to the direction of elongation. Massive granular varieties are also found, and although epidote in this form is not unlike massive pyroxene or idocrase, the peculiar yellowish oily green colour is sufficiently unique to distinguish it. *Zoisite* is grey in colour, and is derived from the plagioclases by their alteration. Saussurite is largely a mixture of zoisite and albite, or paragonite (*see* § 15, page 10). Zoisite also occurs frequently in crystalline schists. *Thulite* is a pink manganiferous variety. *Clinozoisite* may be regarded as zoisite with a little iron, or as *Epidote* poor in iron. The characteristic green colour deepens as the proportion of iron increases, so that clinozoisite differs visibly from epidote in its lighter tints. Epidote is common as an alteration product, and is often associated with chlorite. It is also a characteristic mineral of many metamorphic rocks. In igneous rocks as an original mineral it is rare. *Piedmontite* is a rare brownish-red variety, which occurs in schists and as a secondary mineral in some igneous rocks. *Allanite* is an epidote containing the rare earths, cerium, lanthanum, yttrium, and many others. It is yellowish-brown to black in colour, and, unlike the epidotes, is not unusual in igneous rocks as an original mineral, although it also occurs in crystalline schists.

21. The Zeolites.

The zeolites form a group of hydrated silicates of aluminium with either calcium or alkalis, which readily lose their water before the blowpipe. They are all due to weathering or to the action of thermal waters or vapours on felspars and felspathoids, or on the magmatic material from which those minerals would have crystallised in the absence of the water necessary to form zeolites. They are thus very common in the cavities of volcanic rocks, especially basalts, and also in weathered felspathoid rocks. Analcite is unique in being not only a secondary mineral but also an original mineral in certain deep-seated igneous rocks which have formed under pressure. The table on p. 72 sets forth the chief varieties. It must be noticed that in the calcium zeolites part of the Ca may be replaced by Na.

The hardness is in most cases between 3 and 5, the soda zeolites being just over 5. All the zeolites have a vitreous lustre, and are transparent and colourless or opaque and white. Yellow or reddish tints may be seen but are not common.

Analcite crystallises in trapezohedra like garnet and leucite, being sometimes pseudomorphous after

Name	*Composition*	*System*	*Sp. gr.*
Natrolite	$Na_2Al_2Si_3O_{10}2H_2O$	Orthorhombic	2·2
Analcite	$Na_2Al_2Si_4O_{12}2H_2O$	Cubic	2·3
Phillipsite	$(K_2,Ca)Al_2Si_4O_{12}4\frac{1}{2}H_2O$	Monoclinic	2·2
Thomsonite	$CaAl_2Si_2O_8 2\frac{1}{2}H_2O$	Orthorhombic	3·0
Scolecite	$CaAl_2Si_3O_{10}3H_2O$	Monoclinic	—
Chabazite	$CaAl_2Si_4O_{12}6H_2O$	Hexagonal	2·1
Laumontite	$CaAl_2Si_4O_{12}4H_2O$	Monclinic	—
Heulandite	$CaAl_2Si_6O_{16}5H_2O$	Monoclinic	2·2
Stilbite	$CaAl_2Si_6O_{16}6H_2O$	Monoclinic	2·2

the latter mineral. It can be distinguished from leucite by giving off water before the blowpipe.

Natrolite most frequently occurs in long prismatic needles and fibres which radiate from a common centre.

Stilbite also builds radiating aggregates which have a sheaf-like form. Its crystals have a perfect cleavage with a pearly lustre.

Heulandite has also a perfect cleavage and a pearly lustre, but the crystals are tabular in habit, and a large number of parallel plates (parallel also to the cleavage) have generally grown together side by side.

Two other minerals should be mentioned under this group, although they do not strictly belong to it:

Apophyllite, $HKCa(SiO_3)_2.H_2O$, differs from the zeolites in containing no aluminium, although it occurs like them and is associated with them in the amygdaloidal cavities of basalt. It is tetragonal, and has a perfect cleavage parallel to the base, which has a pearly lustre. The colour is white, or pale tints of other colours. H = 4½. Sp. gr. = 2·3.

Prehnite, $H_2Ca_2Al_2(SiO_4)_3$, is an orthorhombic mineral that is associated with zeolites, but which does not lose water except at a red heat. It occurs in curious barrel-shaped groups of white, pale green, or grey platy crystals. H = 6 to 6½. Sp. gr. = 2·9.

22. Scapolite.

Scapolite is the name given to what is really a group of tetragonal minerals made up of isomorphous mixtures of the following:

Me = Meionite, $Ca_4Al_6Si_6O_{25}$. Sp. gr. 2·72.
Ma = Murialite, $Na_4Al_3Si_9O_{24}Cl$. Sp. gr. 2·57.

Both of these, although rare, occur in crystalline limestones in Central Italy: and common scapolite, which is of far greater importance, appears to approximate to the composition indicated by Me_3Ma.

Scapolite occurs in good transparent or translucent tetragonal crystals, but granular masses are also common. The colour varies from grey to tints of blue-green and red-brown. H = 5½ to 6. The mineral occurs in crystalline limestones and schists generally as the result of contact metamorphism. Alteration products are like those of the plagioclase series.

23. Idocrase or Vesuvianite.

Idocrase is a tetragonal mineral crystallising in thick square prisms. Its chemical composition is variable, and may be best expressed as a combination of $Al_2Ca_9(SiO_4)_6$ and $Al_2Ca_7(AlOH)_2(SiO_4)_6$, in which a little fluorine may replace the hydroxyl. The colour varies in shades of brown and green. Transparent and translucent crystals are common, and radiating and granular varieties are also found. The lustre is vitreous. H = 6½. Sp. gr. about 3·4.

24. Tourmaline.

There are a large number of varieties of tourmaline which depend on the varying chemical composition. The latter is very complex, and the two following formulæ have been proposed to express it:—

$H_9Al_3(BOH)_2Si_4O_{19}$ } H = Na, K, Li, F.
or, $H_{14}Al_5B_3Si_6O_{31}$ } H_2 = Fe, Mg, Mn, Ca.

A convenient classification may be based on the characteristic metal, thus:

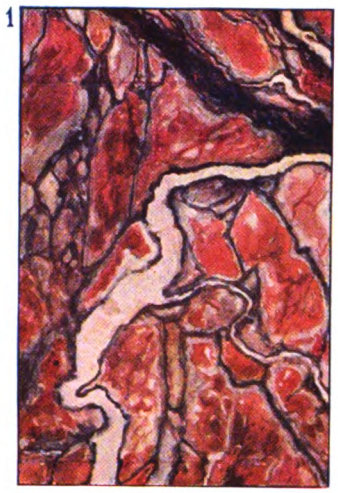
Alkali Tourmaline, pink, red, blue, or green; usually found in pegmatites associated with lepidolite and beryl. These varieties, when transparent and flawless, may be used as gems.

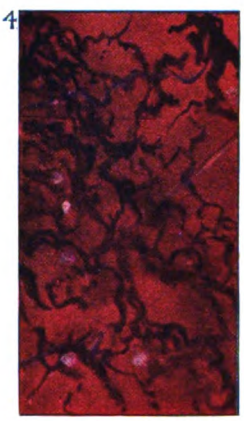
Magnesian Tourmaline, brown; occurring in pegmatites, but more generally in crystalline limestones and dolomites, associated with phlogopite.

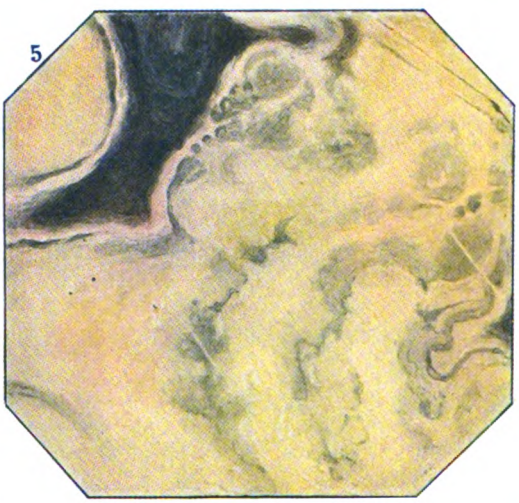
Iron Tourmaline, black; known as *Schorl*; found abundantly in pegmatites and crystalline schists and limestones, associated with muscovite and biotite, cassiterite, topaz, etc. From its mode of occurrence tourmaline appears to be formed from other minerals, felspars and micas, etc., by the action upon them of boron-bearing vapours from igneous magmas. It may, however, sometimes be primary.

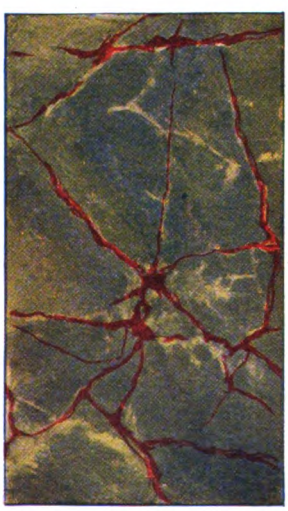
Crystals are hexagonal and prismatic, either long and slender or short and stout, with striations and grooves parallel to the length, and a characteristic triangular cross-section. Parallel and radiating groups of prisms are of frequent occurrence, but a massive form is rare. There is no good cleavage. The lustre is vitreous and the mineral is generally opaque. H = 7 to 7½. Sp. gr. = 3 to 3·2, according to the composition.

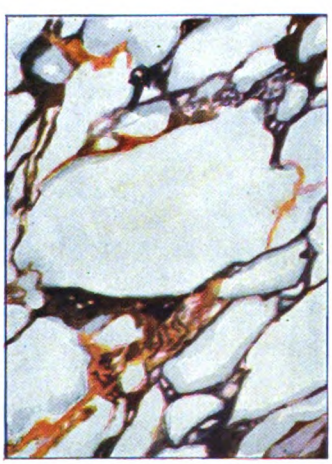
Another borosilicate, formed, like tourmaline, by the action of magmatic vapours carrying boron, is *Axinite*, $HCa_3Al_2B(SiO_4)_4$, which occurs in cracks or veins near the contacts of granite and other igneous rocks. It is well crystallised in a characteristic axe- or wedge-shaped form. The colour is clove-brown and the lustre is brilliant, approaching adamantine. H = 6½. Sp. gr. = 3·28.









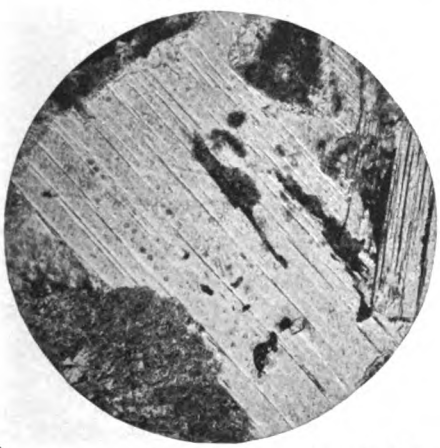


1, "Africano Sanguigno," from the ruins of ancient Rome; 2, "Giallo di Siena," from Siena, Tuscany; 3, "Grande Antique des Pyrénées," from the South of France; 4, "Griotte," from Languedoc; 5, a serpentinous marble from India; 6, Fire-marble, from Bleiberg, Carinthia; 7, Green marble, from La Toma, Argentine; 8, Veined marble, from Seravezza; 9, Pink marble, from the Tyrol.

TYPES OF MARBLE.

OLIVINE: Showing form and alteration to Serpentine along cracks; in Olivine basalt from Thuringia.

SERPENTINE: With islands of unaltered Olivine; in Peridotite from Markuch, Vosges.



MUSCOVITE: Showing the well-marked basal cleavage; in Granite from the Cheesewring, Cornwall.

BIOTITE: Showing characteristic appearance and cleavage; in Minette from Helmsgill. Yorkshire.

GARNET: Showing rounded form and lack of cleavage; in Eclogite from Mozambique.

TOURMALINE: Triangular section; in Elvan Dyke, Cornwall.

PHOTOMICROGRAPHS OF MINERALS,
as seen in this section under the microscope.

25. Beryl,

Hexagonal, $Be_3Al_2(SiO_3)_6$, is familiar as a gem stone. Sea-green varieties are known as *Aquamarine*, and darker green as *Emerald*. It is found in pegmatites and in some schists and crystalline limestones. Tourmaline and topaz are common associates. It occurs in pale green or dark green hexagonal prisms or pyramids, which are transparent or opaque and have a vitreous lustre. Massive varieties are very like apatite, but may be distinguished by the superior hardness: H = 7½. Sp. gr. = 2·7.

26. Topaz,

Orthorhombic, $Al(AlF_2)SiO_4$, crystallises in pointed prisms with a perfect cleavage parallel to the base. It is generally transparent and colourless, but may be yellow or brown. The lustre is vitreous. It is a very hard mineral: H = 8. Sp. gr. = 3·5.

Transparent golden yellow and brown varieties are used as gem stones, and by careful treating the tint may be changed to pink. Topaz is found in granites and pegmatites, and its production depends on the action of fluorine-bearing magmatic vapours. It is especially characteristic of cassiterite-bearing pegmatites.

27. The Aluminium Silicates.

There are three minerals which have a special interest in that all of them have the same chemical composition, Al_2SiO_5. They differ in internal structure, as the following details show:—

Name	*System*	*H*	*Sp. gr.*
Andalusite ..	Orthorhombic	7·5	3·2
Sillimanite or Fibrolite ..	Orthorhombic	6·5	3·25
Kyanite ..	Triclinic	7	3·6

All three minerals occur in metamorphic rocks, and especially in crystalline schists formed from aluminous (clay) sediments. Sillimanite is formed from the others at a temperature of 1,380° C., and is therefore the stable form under high temperature conditions. Again, other conditions being equal, andalusite forms under low pressures and kyanite under high. The conditions of formation are, however, not yet completely understood, and the particular mineral which forms evidently depends on other factors besides temperature and pressure.

Andalusite, $Al(AlO)SiO_4$, occurs in nearly square prismatic crystals, white to red-brown in colour.

Sillimanite occurs in slender parallel or radiating fibres, whence its name, fibrolite. It is associated with cordierite and staurolite.

Kyanite, $(AlO)_2SiO_3$, occurs in long blade-like crystals of a white to blue colour. It is remarkable for the variation of its hardness with direction —7 along the length of the crystal, but only 4 at right angles; for this reason it has been called *Disthene* (double strength). It occurs under conditions of intense metamorphism in schists and gneisses, and is associated with garnet and staurolite.

All three minerals alter to kaolin, and in the presence of alkaline waters to mica.

28. Staurolite,

Orthorhombic, $(AlO)_4(AlOH)Fe(SiO_4)_2$, is generally crystallised in thick six-sided prisms, which are often twinned, and it is from this that the name, which means "cross-shaped stone," is derived. The colour is yellowish-brown or red to black, and the surface is often dull from alteration. H = 7 to 7½. Sp. gr. = 3·7.

Staurolite is closely allied to the aluminium silicates just described, and, like them, is a mineral of the argillaceous and mica schists. It is formed where a little iron oxide is present, and where the conditions favour the retention of water. Kyanitei, sillimanite and garnets are its characteristic associates.

Another mineral formed under similar conditions is the blue orthorhombic *Dumortierite*, $Al_8HBSi_3O_{20}$.

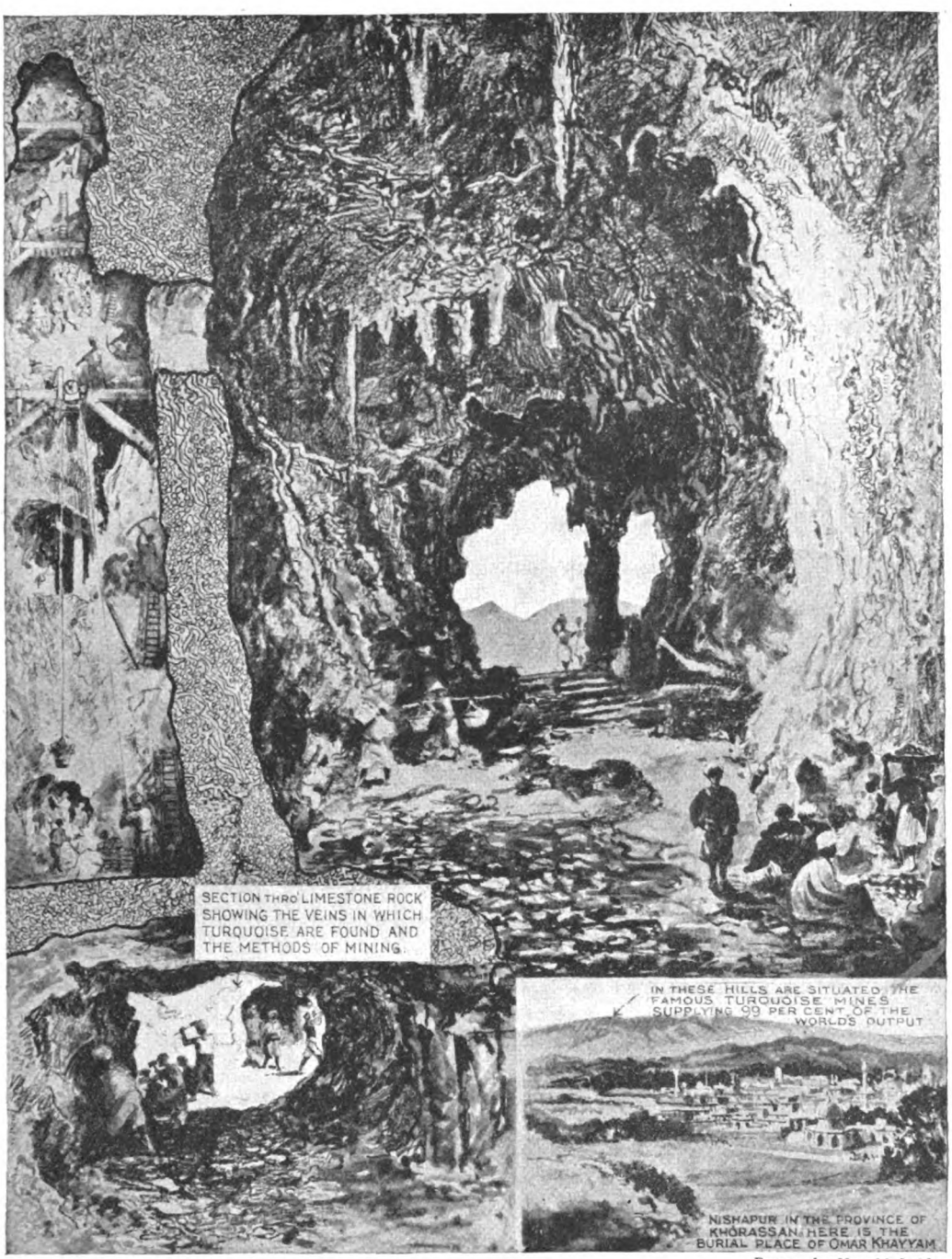
29. Cordierite,

$H_2(Mg,Fe)_4Al_8Si_{10}O_{37}$, is an orthorhombic mineral with a blue or smoky grey colour, which may occur in igneous rocks but is more common in schists and gneisses, where it has sillimanite as a frequent associate. It is generally granular or massive, but short prismatic crystals are sometimes found. H = 7 to 7½. Sp. gr. = 2·65. It readily alters by hydration to a mica-like mineral *pinite*, or to a variety of chlorites.

30. Zircon.

Zircon, $ZrSiO_4$, is one of the most widespread accessory minerals of igneous rocks. It occurs in small tetragonal crystals consisting of a short prism terminated with a pyramid. The lustre is adamantine, and the colour varying shades of brown. H = 7½. Sp. gr. = 4·7. Clear, transparent crystals make good gem stones, either colourless, orange to red (jacinth), or pale green (jargoon). Zircon withstands weathering successfully, and is therefore found in heavy sands with minerals like cassiterite, magnetite and garnet. The following tetragonal minerals constitute an important isomorphous group:—

Name	*Composition*	*H*	*Sp. gr.*	*Colour*
Zircon	$ZrSiO_4$	7·5	4·7	Brown.
Thorite	$ThSiO_4$	5	4·9	Orange-black.
Rutile	$TiTiO_4$	6·5	4·3	Brown-black.
Cassiterite	$SnSnO_4$	6·5	7	Brown and grey.
Xenotime	YPO_4	4·5	4·5	Yellow-reddish brown.



Drawn by Harold Oakley

TURQUOISE MINING

at Nishapur, in Khorassan, the Persian city where Omar Khayyam was born and buried, and whence come 99 per cent. of the world's turquoise. The mine shown above is entered by a natural cave, opening in the side of the mountain, and is worked by means of rough shafts and levels. The most highly prized varieties are of a deep azure. Many have this colour when first mined, but fade with exposure to light and air.

31. Sphene or Titanite.

Another important accessory mineral of igneous rocks is sphene, $CaTiSiO_5$, which also occurs in schists and crystalline limestones. It is monoclinic, and builds wedge-shaped tubular crystals with an adamantine lustre and a brown colour. The largest crystals are found in metamorphic rocks. H = 5½. Sp. gr. = 3·5.

Ilmenite, $FeTiO_3$, an iron-black mineral resembling hæmatite, sometimes alters to a white earthy form of sphene known as *leucoxene*.

Perovskite, $CaTiO_3$, is an orange to dark brown cubic mineral which occurs in some basic igneous rocks, where it often has melilite as a companion. It is also found in schists and crystalline limestones.

32. Precious Stones.

The chief minerals which are in common use as gems are given in the table at the bottom of this page.

A number of the varietal names (by which the stones are known to jewellers) are quoted in the list in the next column, together with the corresponding colours.

The essential features, it may be explained, of a valuable gem-stone are beauty, durability and rarity. Beauty depends both on colour and brilliance, the latter character reaching its greatest perfection in the diamond. Turquoise, on the other hand, is opaque and relies for appreciation on its colour. The beauty of precious opal resides in its flashing play of colours, and moonstone derives its charm from the milky opalescence of its interior. The necessity for durability is obvious, for a mineral to be used as a gem must be hard in order to take and keep a polish, tough to resist fracture, and chemically durable to resist atmospheric decay.

The list which is given below is by no means complete, for a large number of silicate minerals such as enstatite, epidote, sphene, and apatite may, when transparent and beautifully tinted, be valuable as gems. Their occurrence and use in this way are, however, rare. It should be noticed that the varietal names employed in jewellery do not always agree with the mineralogical usage. The cases of olivine and chrysolite are perhaps the most confusing.

Mineralogical usage.	*Jewellers' usage.*
Olivine, Chrysolite	Peridot.
Andradite garnet	Olivine.
Beryl	Chrysolite.

THE CHIEF VARIETAL NAMES USED FOR GEMS

Garnet is represented by Nos. 7, 9, 10, and 16.

2	Ruby	Red.
	Sapphire	Blue.
	Oriental Emerald	Green.
	Oriental Topaz	Yellow.
	Oriental Amethyst	Violet.
3	Chrysolite	Yellowish green.
	Alexandrite	Dark green (but pink in artificial light).
4	Cat's Eye	Brownish green.
	Balas Ruby	Rose red.
	Rubicelle	Orange.
6	Emerald	Grass green.
	Aquamarine	Sea green.
	Morganite	Rose red.
7	Carbuncle	Crimson and violet.
8	Jargoon	Yellow to green.
	Jacinth	Orange to red.
9	Cinnamon Stone	Golden yellow.

The numbers refer to the minerals in the table given below.

Here we must conclude our all too brief survey of the mineral kingdom, and turn to the wider subject of geology, in which rocks and the processes they undergo will claim our attention.

MINERALS USED AS PRECIOUS STONES

No.	*Name*	*Composition*	*System*	*H*	*Sp. gr.*
1	Diamond	Carbon	Cubic	10	3·52
2	Corundum	Al_2O_3	Hexagonal	9	4·03
3	Chrysoberyl	$BeAl_2O_4$	—	8·5	3·73
4	Spinel	$MgAl_2O_4$	Cubic	8	3·60
5	Topaz	$Al(AlF_2)SiO_4$	Orthorhombic	8	3·53
6	Beryl	$Be_3Al_2(SiO_3)_6$	Hexagonal	7·5	2·74
7	Almandine	$Fe_3Al_2(SiO_4)_3$	Cubic	7·5	3·9
8	Zircon	$ZrSiO_4$	Tetragonal	7·5	4·2—4·7
9	Grossular	$Ca_3Al_2(SiO_4)_3$	Cubic	7·25	3·5
10	Pyrope	$Mg_3Al_2(SiO_4)_3$	Cubic	7·25	3·7
11	Tourmaline	*See* § 11	Hexagonal	7	3·10
12	Quartz	SiO_2	Hexagonal	7	2·66
13	Nephrite	$Ca(Mg,Fe)_3(SiO_3)_4$	Monoclinic	7	3·00
14	Judeite	$NaAl(SiO_3)_2$	Monoclinic	6·5	3·34
15	Olivine	$(Mg,Fe)_2SiO_4$	Orthorhombic	6·5	3·40
16	Andradite	$Ca_3Fe_2(SiO_4)_3$	Cubic	6·5	3·8
17	Spodumene	$LiAl(SiO_3)_2$	—	6·5	3·18
18	Opal	$SiO_2.xH_2O$	Amorphous	6	2·15
19	Orthoclase	$KAlSi_3O_8$	Monoclinic	6	2·57
20	Turquoise	$Cu(AlOH)_5(PO_4)3H_2O$	Triclinic	6	2·82

A. H.

ANATOMY AND PHYSIOLOGY IX

WE have already seen (pp. 13–15) that the object of the circulatory system is to maintain a constant flow of blood through the tissues, in order that the exchange of foodstuffs and waste, and of oxygen and carbon dioxide, may take place between the two, and that this exchange occurs in the capillaries.

The circulatory system is a double system of tubes. The movement of the blood depends on the heart-beat, which forces blood into the arteries, where it can be felt as the *pulse*. The jerky movement of the heart-beat is changed into a steady flow in the capillaries by the elastic tissue in the artery wall. After passing through the capillaries the blood enters the veins by which it returns to the heart.

The systemic circulation consists of the arteries which start from the left ventricle and are distributed to the whole body except the lungs; its veins enter the right auricle. The blood then passes to the right ventricle, and leaves it by the pulmonary arteries which take it to the lungs. It leaves these by the pulmonary veins which lead back to the left auricle, and so complete the circuit.

The Heart and—

The heart is enclosed in a bag called the pericardium, which means something round the heart. It is a bag of tough fibrous tissue called the *fibrous* pericardium and it is lined with a smooth membrane called the *serous* pericardium, and there is a similar layer of serous pericardium covering the heart itself. Serous means a surface moistened by serum. There is a little of this lubricating fluid between the heart and the pericardium.

The reason for this is, that when the heart contracts, it changes in size, and also slightly changes its position; and if it were not free to move, if there were other organs fixed tightly on to its outside, in contraction it would have to pull these organs with it.

Sometimes in illness the heart gets stuck to the pericardium. The importance of the pericardium is this: If you have to pull a cart with well lubricated wheels you have only the weight of the cart on your shoulders. But if at the same time your axles are rusty, your work will be much heavier; the pericardium with its fluid supplies the place of smooth and lubricated axles.

All the organs which are movable have serous coverings of some kind, and as the pericardium is the simplest, it will be described in detail.

Imagine the fibrous pericardium as an oval bag with an open mouth, and the heart as being made of muscle without any covering. You could represent the serous pericardium as a child's empty air balloon. Stretch this over the mouth of the fibrous pericardium and then force the heart in on the top of it, and imagine that the part which is thus spread over the heart becomes attached to it, and the part which covers the inside of the fibrous pericardium becomes attached to that, and you have the arrangement of the serous pericardium. Within the cavity of the empty balloon are a few drops of serous liquid, and the heart can contract easily without sticking.

The fibrous pericardium is continuous above with the coverings of the vessels which enter and leave it. It lies in the front of the chest, behind the sternum and the neighbouring rib cartilages. On each side of it is the pleura, behind it are the œsophagus, the aorta and the bronchi. Below it is attached to the diaphragm.

—its Various Parts

When the pericardium is cut open the heart can be seen inside. It appears as a cone-shaped organ, whose point is directed downwards and to the left, and whose upper end or base is directed upwards and to the right. Most of the surface which one sees from the front is formed by the right ventricle, but on the left side a little of the left ventricle is to be seen.

Above the ventricle the auricles can be seen, chiefly the right. Between the auricles are the great vessels; on the right the superior vena cava entering the right auricle, and on the left the pulmonary artery leaving the right ventricle. Between the two the arch of the aorta can be seen.

When the heart is removed from the body, by cutting through the vessels, which are the only things that attach it to its surroundings, its parts can be at once made out.

If a heart is removed from the body and put before you, it is easy to make out all the chief parts. Arrange it with its front side upwards and its tip pointing towards you. You will see that it is cone-shaped and that all the lower part of the cone is firm and hard, especially on its left side; this is due to the thick-walled ventricles. The tip of the cone is called the *apex*. The upper part or base is broad, and much softer and flabbier to the touch. It forms the auricles, from

each of which there is a loose pouch projecting forwards and folded round, called the *auricular appendix*.

When cut open the heart is seen to consist chiefly of muscle, which varies in thickness in different parts. Outside the muscle is the serous pericardium, already described, which is closely attached to the muscle. Inside is a similar smooth membrane called the *endocardium*, which is also tightly attached to the muscle.

The heart muscle when seen under the microscope is peculiar and differs both from voluntary and involuntary muscle. It consists of rather squat four-sided cells joined end to end, and showing both cross stripes as in voluntary muscle and long stripes as in involuntary muscle.

Cavities of the Heart

The cavities of the heart may now be taken. The auricles are two thin-walled cavities placed side by side and separated by a thin sheet of muscle called the *septum auriculorum* (the division between the two auricles). The main cavities are square, but on the outer side of each is a sort of side chamber, and the loose conical bag which projects forwards is called the *auricular appendix*.

The superior and inferior venæ cavæ open into the left auricle, the superior from above and the inferior from below, the pulmonary veins from both lungs open into the back of the left auricle. The inner surface of each is smooth, except in the appendix where there are some fleshy ridges.

Leading from the auricles to the ventricles, on each side is the *auriculo-ventricular orifice* which is a ridge of fibrous tissue that joins the auricle to the ventricle. Each is a hole of some size : you can pass the tips of four fingers through the one on the right, and three fingers through that on the left. Attached to this ring are the valves which control the flow of blood from auricles to ventricles, and only allow it to pass in that direction.

The valves are made of triangular flaps which are attached above to the ring and hang down into the ventricles. At their edges there are a number of fine tendons, which are attached to little muscular projections on the inside of the heart (called the *musculi papillares*).

The valve on the right side has three flaps and is called the *tricuspid* valve. That on the left has only two flaps and is called the *mitral* valve; it is supposed to be something like a bishop's mitre. It is easy to remember that the mitral valve is on the left, because Huxley, after an argument with a bishop, finished up by saying " Bishops are never in the right."

These valves really form funnels, through which blood is poured from auricles to ventricles, and during the contraction of the ventricles they are squeezed together and become water-tight.

The ventricles have stout muscular walls. The left is much the thicker of the two because it has to force blood all round the body; the right only has to force it through the lungs. The inner surface of the ventricles is ribbed all over with pillars of muscle, the whole of both ventricles being lined with the smooth membrane called the endocardium (the thing within the heart). The endocardium consists of a single layer of flat cells, joined edge to edge, like tiles in a pavement. The whole circulatory system is lined by cells of this sort, outside the heart itself; they are called *endothelium* or *endothelial cells*.

The two ventricles are separated from each other by a wall of muscle called the *septum ventriculorum*. Each ventricle holds about six tablespoonfuls of blood (three fluid ounces).

Arteries

The blood leaves the right ventricle by the pulmonary artery, and the left ventricle by the aorta.

The pulmonary artery starts from the front of the right ventricle, high up and close to the groove between the ventricles. It soon divides into right and left branches for the two lungs. The aorta leaves the left ventricle at its upper and inner part. It runs upwards and inwards for a little way and then arches backwards and to the left and runs down the back of the chest.

In both the pulmonary artery and the aorta the blood is prevented from flowing back into the ventricles by valves called the *semilunar valves*, which means half-moon shaped.

They are made of folds of the endothelial lining membrane of the artery, and they form pockets on its inner walls. There are three in each artery just beyond the heart, arranged in a ring. When the heart beats and forces the blood on, the pockets are emptied, and pressed back against the wall. But between the beats the blood falls back towards the heart, to be caught in the pockets.

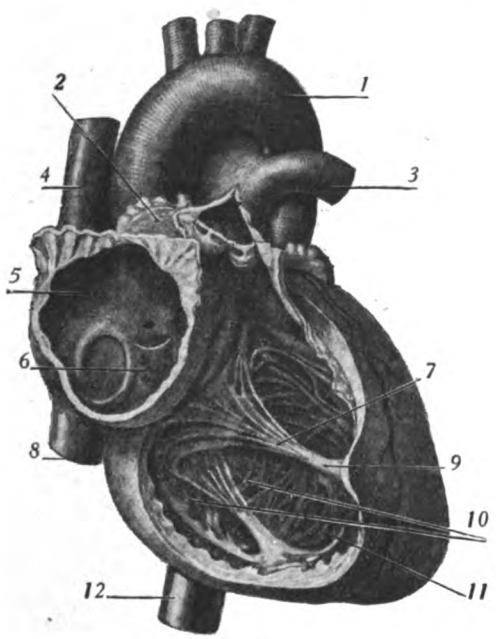
When the pockets are full they all meet and fill up the whole width of the artery,

aorta are to carry blood to the heart itself, for the heart is constantly at work and requires fresh food and oxygen. These arteries are called the *coronary* arteries; there are two of them, right and left, and they run in the grooves between auricles and ventricles and send branches down the groove between the ventricles.

The arteries are made up of three coats, like the outer and inner tubes of a bicycle tyre, but much more closely joined together. The outer coat is made of connective tissue, the middle coat of mixed involuntary muscle and elastic, and the inner coat consists of a well-marked layer of elastic and a single layer of endothelial cells, just the same as those lining the heart.

The bigger the artery, the more elastic it contains. In the smaller arteries the elastic disappears altogether and the middle coat is made of muscle only.

This muscle in the small arteries is very important: by it the flow of blood to different parts of the body is regulated. For instance,



THE HEART.

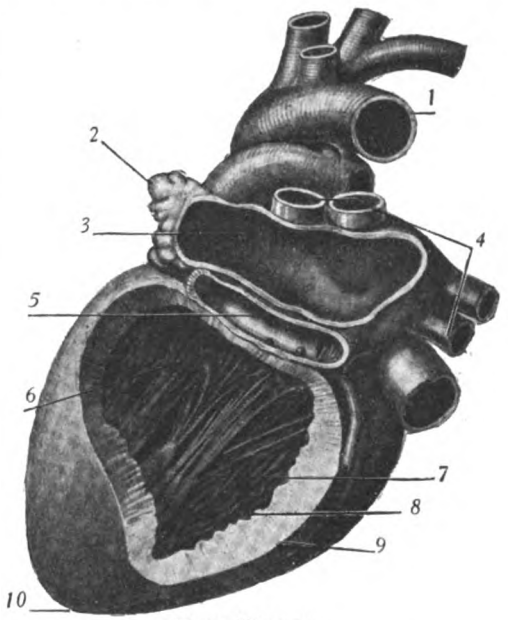
Diagram showing the right Auricle, etc.

1. Aorta; 2. auricular appendix; 3. pulmonary artery; 4. superior vena cava; 5. right auricle; 6. valve of Thebesius; 7. chordæ tendineæ; 8. inferior vena cava; 9. musculi papillares; 10. tricuspid valve; 11. right ventricle; 12. thoracic aorta.

if you are digesting food, more blood is wanted in your intestines, so the arteries about your intestines relax, and those of the rest of the body remain a little contracted. Consequently the capillaries of the intestines get full of blood.

The capillaries consist of one layer of endothelial cells only.

The veins have similar coats to the arteries, but the middle coat is much thinner and weaker. In the legs the flow of blood in the



THE HEART.

Diagram showing the left Auricle, etc.

1. Aorta; 2. auricular appendix; 3. left auricle; 4. pulmonary veins; 5. coronary sinus; 6. mitral valve; 7. left ventricle; 8. serous pericardium; 9. fibrous pericardium; 10. apex.

veins is upwards, so the veins contain valves, like the semilunar valves described in the aorta, which help to support the blood, and make it easier work for the heart.

The heart-beat can be best felt by pressing your finger into the space between the fifth and sixth rib spaces on the left at a point just inside the breast-nipple. It is due to the fact that the muscle fibres of the heart run in a curved direction, and when they contract they lift the apex, or point of the heart, up against the chest at this point, which is called the *apex beat*.

The pulse can be felt in any artery which can be pressed against a bone. It is most easily felt at the wrist by pressing the radial artery against the radius. It is due to the increase of pressure in the artery which follows the heart-beat.

The different parts of the heart can be seen on a sheep's heart bought at the butcher's. The student should examine all the cavities carefully. D. W. C.-J.

ZOOLOGY.—XXVII

FEW people realise the vast numbers of Worms which are to be found in so many different conditions of existence round about us. Regarding it, as we do, as the lowest form of life, though such a view is far from being a correct one, we give the worm at all times the slightest attention, and are loath to pay it a higher compliment than a grudging admission that it may possibly be of interest to the Naturalist.

Worm-like Invertebrates

The worm plays an important part in agriculture; it is the agent of sickness in man and beast and, what is even more unexpected, it may claim in certain species to be a thing of undeniable beauty.

The movement of the Worm is peculiarly its own. It has no limbs, its body is not

Photo: F. Martin Duncan, F.R.P.S.

COMMON SEA MAT

lives in colonies which are often mistaken for seaweed. A section, such as is shown above, examined under a microscope, will be found to contain a number of cells, each occupied by one of these creatures.

jointed like that of the Crustacean or the Insect. But whatever may be the shape of the body it is composed of incomplete segments, and it is upon these segments, or rather upon minute organs attached to the exterior of each segment, that the worm relies when it desires to move.

The process of movement in the worm may be illustrated by the Common Earthworm, which carries attached to each body segment a number of minute bristles, which

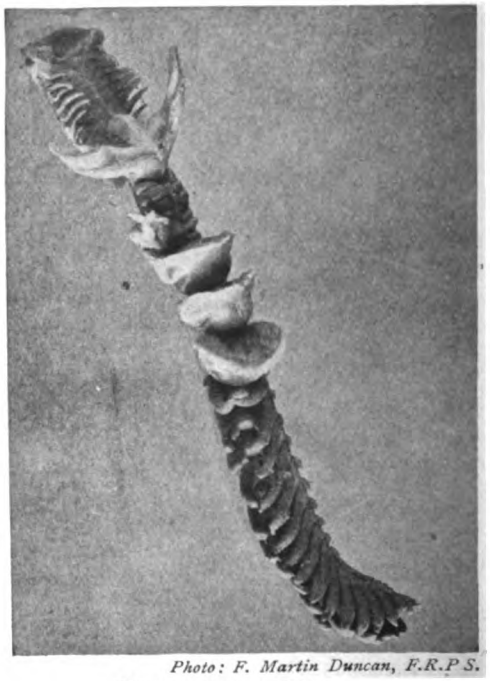


Photo: F. Martin Duncan, F.R.P.S.

VARI-FOOTED WORM,

belonging to the family of the *Phyllodocidæ*, lives in a U-shaped tube which it builds and coats with small stones and sand.

when thrust against the earth afford a grip. Each segment of the body during the forward march is always pulling, or pushing, or being pulled or pushed. The general appearance of the Earthworm is known to everybody. The head is a long obtuse cone devoid of eyes and jaws, the body is narrow but widens out towards the middle before becoming narrow once more. In the skin and clitellus are situated organs for producing mucus, and a red fluid is to be seen circulating through the body.

Water Worms

The reproductive organs are hermaphrodite, and in the food canal may be found a gizzard or mill for grinding up the swallowed soil, the residue of which is cast forth in the form of cylindrical twists of mud or sand. The worm lays its eggs at some depth in the soil during the spring; they hatch during the summer.

The Earthworm is very widely distributed,

and is to be found in many places to which it is hard to explain how he first obtained access; it is found, in fact, on oceanic islands which show no indication of ever having been a part of the mainland. Its habits are nocturnal.

Amongst the Water and Mud Worms occurs a type known as the *Nais proboscidea*, in which the head is distinct from the body. These worms live on small animals and are oviparous. But what is truly remarkable about these creatures is their method of reproduction, which has been aptly described as spontaneous division. By this method of procedure a second head makes its appearance not far removed from the tail, and shortly afterwards the animal divides, becoming two perfect worms.

Leaf-bearing Worms

The *Phyllodocidæ*, or leaf-bearing worms, are easily distinguished by the double row of leaf-like cirri on each side of the body. They are swift in their movements and very graceful. One of the most interesting examples is the vari-footed worm (*Choetopterus Variopeatatus*); this creature builds for itself a U-shaped tube of a parchment-like substance which it coats with small stones and sand.

The Lug-Worm belongs to the sub-order *Tubicolæ* or Tube-Makers, the members of which live in more or less solid tubes which they manufacture from sand and other substances solidified by mucus. The Lug-Worm, though the best-known member of this group, is an exception to this rule, since it does not construct a tube but gains a tube-like residence by burrowing into the sand or mud. The burrowing process is somewhat peculiar. The Lug-Worm, it is said, swallows the sand in front of it and passes it through its intestinal canal. It is found on all the coasts of Europe.

Leeches

On the sea shore at low tide, particularly in the south of England, the little Sea Mouse may occasionally be seen. Beautifully coloured, 8 to 10 inches in length, with a fine bristly coat, this little creature burrows in the sand as the tide goes out and remains safely hidden, occasionally showing itself just as the tide is coming in.

The Leeches, once valued for surgical purposes, are included in the sub-class *Hirudinea* of aquatic creatures furnished with cup-like suckers. The colour of the Medicinal Leech is a greenish olive or very dark green with six yellow-reddish or yellow bands along the back. The under parts are yellowish-green with black spots.

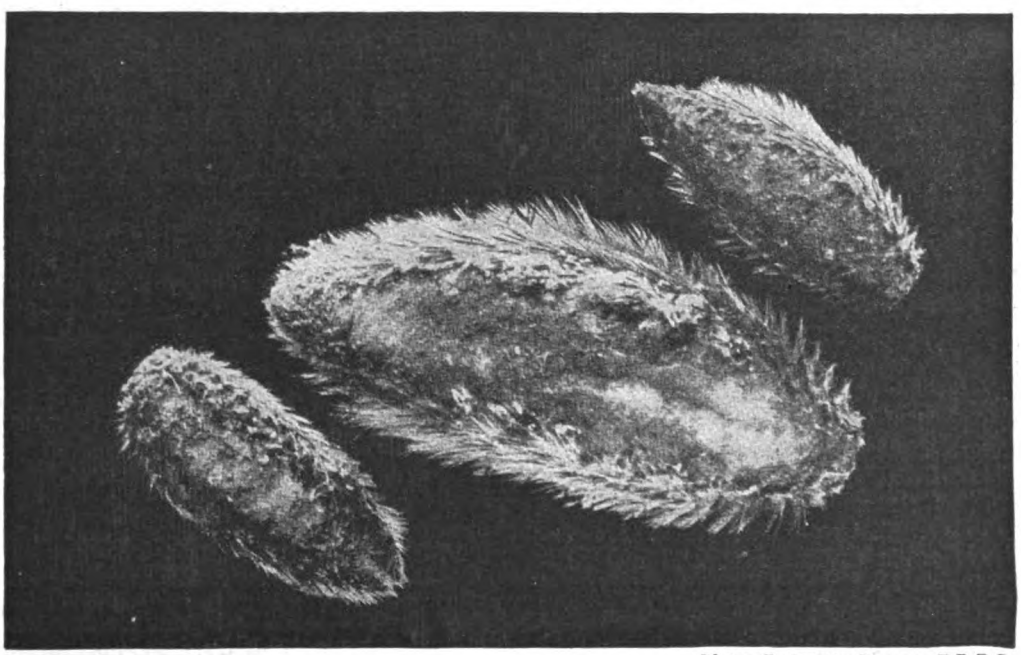


Photo: F. Martin Duncan, F.R.P.S.

SEA MICE,

beautifully coloured, 8 to 10 inches long, may occasionally be seen on the sea shore. The little creatures burrow in the sand as the tide goes out, and usually remain safely hidden till the tide returns.

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In the early days of its life the Leech lives upon the blood of Insect larvæ which it finds in the water. Later when it has developed in size it attacks frogs and even fishes. At a still later stage the Leech takes to leaving the water and wandering in damp places. Should it here encounter a warm blooded animal it atones for many a prolonged fast by gorging itself to repletion. It is consoling to learn that one really satisfactory meal will last the Leech for a considerable time. A space of from six months to two years is said to be occupied in the process of digestion. The Horse Leech is about four and one half inches broad, and is found in lakes and ponds. Another so-called Horse Leech the *Aulostoma gulo* is prepared to attack all kinds of fishes, and even its own kindred, but is not noted for its attacks upon the horse.

The Rotifers or Wheel Animalcules gain their name from the motion of the minute hairs which appear upon the front end of the body. These hairs by their constant movement produce currents of water which carry particles of food to the creature's mouth. They are found universally in salt and pure water, in pools, ponds and gutters and even in the damp earth. Some are parasitic within other animals. All are microscopic. Mr. F. Martin Duncan records the length of one which lives in the intestines of slugs as being one-eightieth to one-forty-seventh of an inch.

The *Polyzoa* are minute aquatic animals which, with one exception, live in large colonies. The Common Sea-Mat, which is easily mistaken for seaweed, may be seen under the microscope to be composed of a very great number of separate cells each of which is occupied by one of these creatures.

Prickly-Skinned Animals

Under the title *Echinoderma* are grouped what are known as the Prickly-Skinned animals. This is, in fact, the meaning of the term which is derived from Greek works signifying "hedgehog" and "skin." Amongst these animals are the Star-fishes, the Sea-Urchins, the Sand and Brittle Stars, that strange group the Sea-Cucumbers and others. All these creatures are exclusively marine and for several reasons—not the least of which is the astonishing change of form which the larva undergoes before becoming adult—they possess great interest for the student of Natural History. The skin of the Echinoderm is tough and leathery, and carries a number of small limestone plates which in some cases overlap each other so as to form a continuous covering.

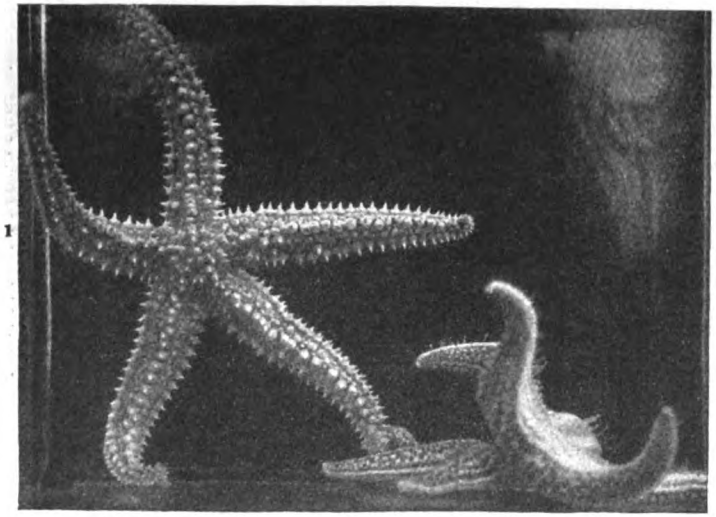
A special feature of the internal anatomy of the Echinoderm is the presence of a number of tubes communicating with the exterior of the body, termed the "Water-Vascular System." These tubes are joined towards the centre of the body by a ring-shaped canal, and towards their extremities thrust the skin outward, forming the tube feet by means of which those Echinoderms, which are not entirely sedentary, are enabled to move about. Again, the connecting ring-shaped canal has direct vertical connection with the exterior by means of what is termed the Stone Canal, which opens on to a porous plate pierced by a number of fine passages. Along the stone canal and its connections are placed powerful celia which produce a strong inward current and thus keep the entire water-vascular system highly charged with sea-water. In other words, the water-vascular system serves the purposes both of locomotion and of respiration.

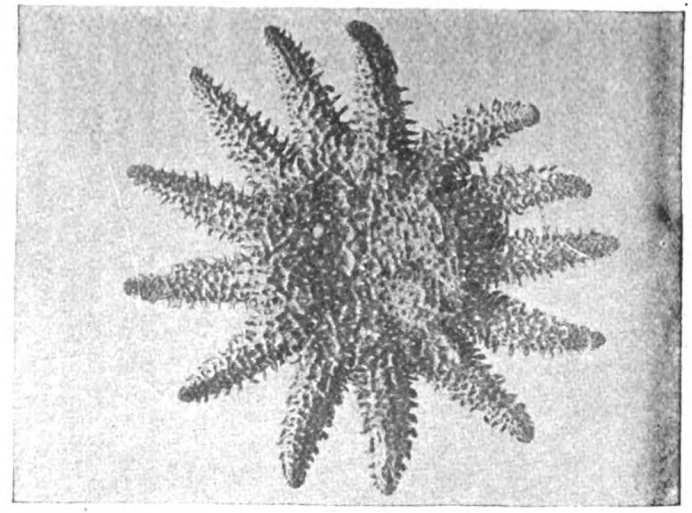
Star Fish

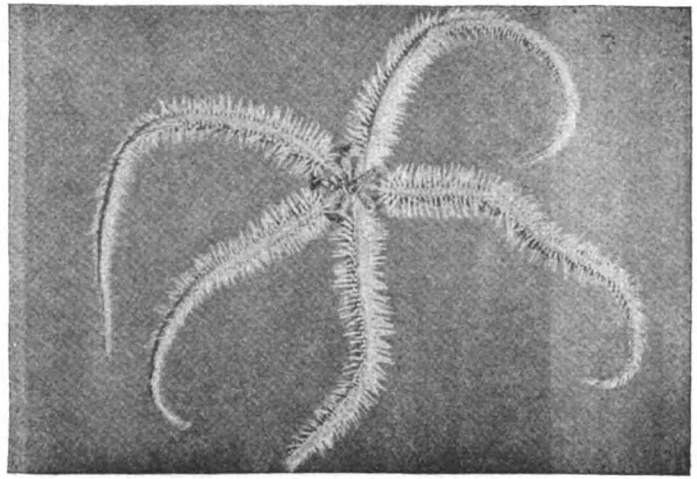
In most of the *Echinoderma* the sexes are distinct and the fertilised ova generally pass through a complicated process of metamorphosis before assuming their adult form, the embryos being for a time free swimming creatures. The two great subdivisions of the *Echinoderma* are known as the *Pelmatozoa*, a group in which the animal is attached by a stalk to a base, and the *Echinozoa*, in which the stalk is absent. As examples of the first group the Feather Stars may be instanced and of the latter the Common Starfish.

The Feather Stars carry five rays, each of which branches out into seven or less other arms, so that the total number may amount to nearly two hundred. Attached to the middle of the back are a number of small clawed hooks by which this creature anchors itself to stones and seaweeds. When it swims, as it occasionally does, it detaches itself and proceeds by alternating movements of the arms. When anchored the arms are more or less completely extended.

The subdivision *Echinozoa* has been again divided into four classes known as the *Asteroidea*, *Ophiuroidea*, *Echinoidea*, and the *Holothuroidea*. The organs for masticating food are most highly developed in the Echinoids, which live on seaweeds and the animals that frequent them; some, however, which are without teeth take up sand or *debris* with their spout-like mouths







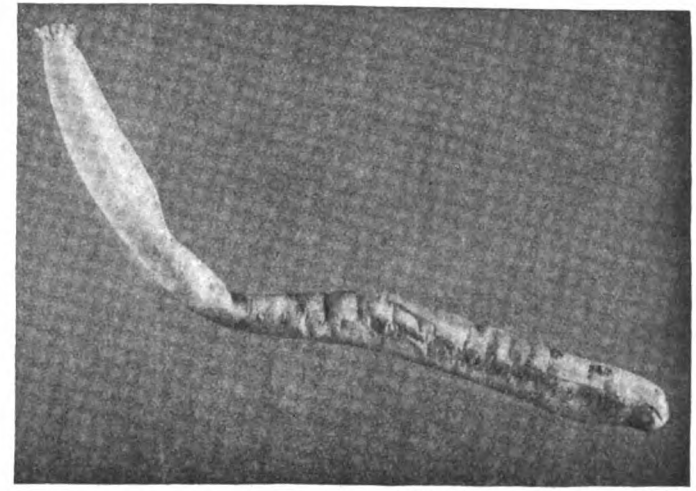


Photo: F. Martin Duncan, F.R.P.S.

STAR FISHES.

1. Star fishes climbing the side of a tank; 2. The common Brittle Star fish; 3. A "Sun" Star fish; 4. A Sea Cucumber, typical of the Holothuroidea class.

and extract from it some nutriment. In the Ophiuroids the edges of the mouth slits are provided with short spinous processes designed for filtering purposes. They live on the smaller foraminifera. Asteroids live on dead fish, oysters and other molluscs, and Holothurians on shell or coral *debris* and the organisms contained there.

The Starfishes are probably the best known and most readily recognised of the *Echinoderma*. In these creatures the shape is maintained by an internal skeleton of limestone joints which are covered by a tough skin.

The tube feet of the Starfish are contractile, permitting the animal by attaching some of them, by their terminal suckers, to draw itself along. Progress is continued by the thrusting forward of other feet which are attached in their turn, those previously fixed being detached. Starfishes are excessively voracious and feed indifferently upon shell fish, crabs, anenomes and all kinds of carrion.

Brittle Stars

In addition to the Common Starfish there are many others belonging to the same division of the Echinoderma.

The members of the *Ophiuroidea* called "Brittle Stars" are distinguished by long serpent-like arms attached to a relatively small and usually rounded body. In this division the tube feet are without terminal suckers, and are concerned rather with respiration than locomotion, movement being effected by the motion of the arms, which are more slender and cylindrical in form than those of the Starfish.

The *Echinoidea*, variously known as Sea Urchins, Sea-Eggs or Sea Hedgehogs, have bodies of globular form which are armed with spines.

The Urchin when climbing over rocks and other uneven surfaces makes use of its tube feet, which are provided with suckers, but when the surface is flat, movement is secured by means of the spines which, as it were, tilt the animal along.

Sea Cucumbers

The *Holothuroidea* or Sea Cucumbers are creatures with elongated and more or less rounded bodies.

The mouth of this fish is at one end of the body and the gullet leads into a long coiled digestive tube, which terminates in a pouch at the opposing extremity. Many of these creatures, which in appearance resemble vegetable rather than animal life, attain a foot in length. They move by the contraction and expansion of the body muscles.

Sea-Cucumbers may be found round our coast amongst seaweed or in sand and mud. In such cases only the tentacles will be seen, the body being effectively hidden in the sand or weed. A. B.

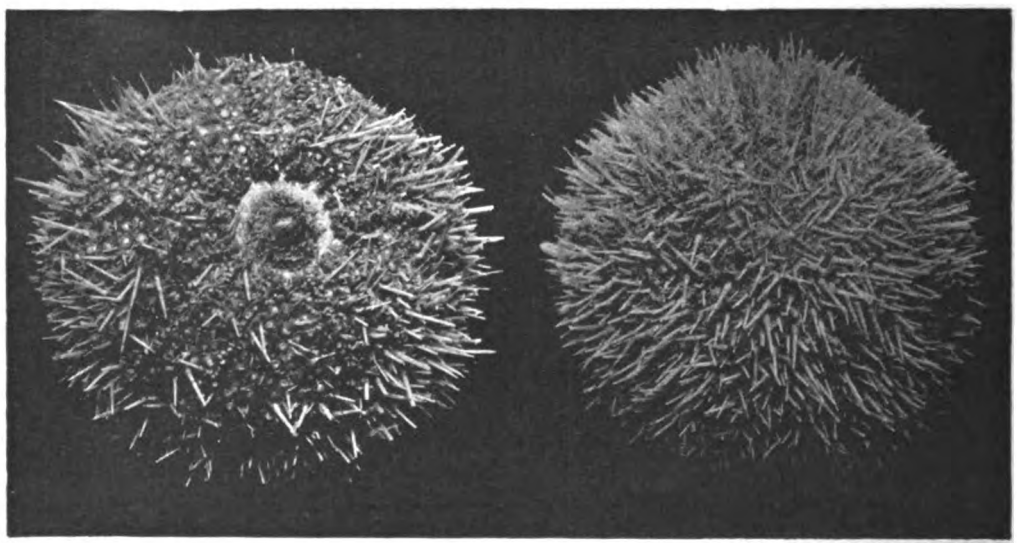


Photo: F. Martin Duncan, F.R.P.S.

SEA URCHINS

have bodies of globular form armed with spines, by means of which they tilt themselves along when moving on flat surfaces. When rock climbing, they make use of their tube feet, which are provided with suckers.

Continued from page 30.

LANGUAGES:

***Contributors*:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).**

LATIN.—XXXI

NOTE that the infinitive is sometimes used as a substantive and sometimes in place of a finite verb. It is with the former use that we are particularly concerned here.

Verbal Substantives

As a substantive it may be grouped with the supine and the gerund, from which it differs in being indeclinable. As a substantive it may be the subject, object, or predicate of a verb ; but since it expresses verbal action it may have a subject of its own, and also a direct or indirect object, following the same construction as the finite verb to which it belongs.

(*a*) The infinite appears as the subject of a finite verb in the following :—

Ingenuas **didicisse** fideliter artes emollit mores.
To have faithfully learned the liberal arts softens manners.
Bene **sentire** recteque **facere** satis est ad bene vivendum.
To think well and act rightly is enough for a good and happy life.
Dulce et decorum est pro patria mori.
It is a sweet and proper thing to die for one's country.

(*b*) After **vĭdĕŏr**, **intellĭgŏr**, **dīcŏr**, and similar verbs, the infinitive often appears as the secondary predicate ; thus :—

Ut beate **vixisse** videar.
That I may appear to have lived happily.
Disciplina in Galliam **translata esse** existimatur.
The teaching is said to have been carried into Gaul.

(*c*) The infinitive is found as the object of a transitive verb in—

Desidero **scire** omnia.
I desire to know everything.
Alexander Ægyptum **proficisi** parabat.
Alexander prepared to set out for Egypt.
Filiam **equitare** docebat.
He was teaching his daughter to ride.

Note that **docĕrĕ** is one of those verbs that take a double accusative, and the infinitive in the last example is what is called the internal object of **dŏcēbăt.**

(*d*) After verbs of saying, perceiving, thinking, &c., and after **iŭbĕō**, *command*, or **vĕtō**, *forbid*, the infinitive and its subject may be used as the direct object of the finite verb, thus :—

Dixit hostes victores **fuisse.**
He said that the enemy were the victors.
Eos suum adventum **expectare** iussit.
He ordered them to await his arrival.
Vetuit oppidanos in murum **ascendere.**
He forbade the townspeople to go up on the wall.
Fama est eos homines ex Asia **advenisse.**
Rumour has it that these people came out of Asia.

(*e*) In poetry or semi-poetical prose the infinitive is used after adjectives and in other constructions where one would look for a gerund or supine. The following examples illustrate these uses :—

Pecus egit montes **visere.**
He drove his flock to visit the mountains.
Mens erat apta **capi.**
The mind was liable to be captivated.
Indocilis erat pauperiem **pati.**
He was untaught to endure poverty.

(*f*) The use of the infinitive in vivid narrative in place of a finite verb differs from those just enumerated as a figurative construction. This is called the historic infinitive. The subject appears in the nominative case, as if the verb were finite ; thus :—

Hostes gladios **destringere** et in Romanos **inruere.**
The enemy draw their swords and charge the Romans.

The tenses of the infinitive present few difficulties. When the time of the action expressed by the infinitive is the same as that of the finite verb it is put in the present tense. When the time of the action is prior or subsequent to that of the finite verb, the perfect or the future infinitive is used. This is illustrated in the following sentences—

Credo eum fortem **esse.**
I believe that he is brave.
Credidi eum fortem **esse.**
I believed that he was brave.
Credo eum fortem **fuisse.**
I believe that he has been brave, or *I believe that he was brave.*

Credidi eum fortem **fuisse.**
I believed that he had been brave.
Credo eum fortem **futurum esse.**
I believe that he will be brave.
Credidi eum fortem **futurum esse.**
I believed that he would be brave.

Supines

The supines of verbs are the accusative and ablative of verbal nouns of the U-declension, of which some instances of the other cases are found.

(*a*) The supine in **-um** is in the accusative denoting the goal of motion, as in :—

Lusum it Maecenas, **dormitum** ego.
Maecenas goes to play, I go to sleep.

It may be followed by a substantive in the accusative or dative case, representing a direct or indirect object. In the following there is an indirect object to the verb :—

Non ego Graiis **servitum** matribus ibo.
I shall not go to be a slave to the Grecian matrons.

(*b*) The supine in **-u** is used chiefly with adjectives as an ablative of respect, and is rare except in the following forms—**auditū**, *to hear*, **dictū**, *to say*, **factū**, *to do*, **nātū**, *by birth*, **vīsū**, *to see*. Examples :—

Horribile **dictu.** *Horrible to tell.*
Mirabile **visu.** *Wonderful to see.*

Gerund

What is known as the gerund is a neuter noun in **-dum**, to which the nearest English equivalent is the verbal noun in -ing.

(*a*) In classical Latin the nominative gerund only of intransitive verbs is used to express obligation, the agent being usually in the dative (sometimes in the ablative governed by **ā** or **ab**) ; thus :—

Fortibus militibus aut **vincendum** aut **moriendum** est.
Brave soldiers must either conquer or die.
Nunc est **bibendum.**
Now is the time for drinking.

(*b*) The accusative gerund is used only after prepositions, usually **ăd**. It cannot have an accusative of the direct object, the gerundive taking its place when this would happen. Example :—

Non solum **ad discendum** propensi sumus, verum etiam **ad docendum.**
We are not only disposed to learn, but also to teach.

(*c*) The genitive gerund is found chiefly after nouns and adjectives, as in **dicendī causā**, *for the sake of speaking*, **ăvĭdŭs vīdendī**, *eager to see*. Sometimes it is followed by an accusative of the direct object ; sometimes the gerundive is used with the object, as will be illustrated below. Example :—

Huc adveni meum amicum **salutandi causa.**
I have come here for the sake of saluting my friend.

(*d*) The dative gerund expresses purpose, and cannot have a direct object, the gerundive taking its place if such is required. Examples :—

Aqua nitrosa utilis est **bibendo.**
Nitrous water is useful for drinking.
Solvendo civitates non erant.
The States were not solvent.

(*e*) The ablative gerund is used with or without a preposition, and in the latter case expresses manner or means. Examples :—

Aristotelem non deterruit **a scribendo** Platonis amplitudo.
Plato's fullness did not deter Aristotle from writing.
Solvitur **ambulando.**
(*The question*) *is solved as one goes on.*

Gerundive

Note again the gerundive, which ranks with the participles as a verbal adjective ; it is commonly used instead of the gerund and a direct object of the gerund, the gerundive agreeing with the object in gender, number, and case. The substantive forming the object of the gerund is usually attracted into the case of the gerundive replacing the gerund. Examples :—

Paratus est ad **suum munus fungendum.**
He is ready to discharge his own duty.
Nihil Xenophonti tam regale videtur quam studium **agri colendi.**
Nothing seems so kingly to Xenophon as the desire of cultivating the soil.
Locum **oppido condendo** eligerunt.
They chose a spot for building the town.
In **voluptate spernenda** virtus cernitur.
Virtue is discerned in despising pleasure.

In the nominative the gerundive expresses obligation, as in—

Diligentia est **colenda.**
One must exercise diligence.
Acta haud facile **superanda.**
Deeds not easily surpassed.

In Latin three participles are employed. Active verbs have a present and a future participle, as **ămans**, *loving*, **ămātūrŭs**, *about to love*. Passives and deponents have a perfect participle, which usually refer to time prior to that of the leading verb ; thus **ămātŭs**, *loved*, **prŏfectŭs**, *having set out*. Perfect participles of deponent verbs often have both passive and active meanings, as **confessŭs**, *having confessed*, or *confessed*, **expertŭs**, *tried*, or *experienced*, **mentītŭs**, *falsified*, or *having lied*, **rātŭs**, *settled*, or *having thought* or *thinking*. We have already noticed the group of perfect participles with active meaning formed from active verbs,

e.g., **cēnātŭs**, *having dined* (from **cēnō**, *dine*), **pransŭs**, *having lunched* (from **prandĕō**, *I lunch*).

Participles may be used attributively, in which case they differ little from adjectives, as in **ămans patrĭae cīvĭs**, *a patriotic citizen*; or predicatively, as in **ămātŭs est rex bŏnŭs**, *a good king is loved*; **victŭs fŭgĭt**, *he was conquered and fled*, or **Damnātum occīdunt**, *they condemned and killed him.*

They often take the place of a temporal or relative clause, as in :—

Alexander **moriens** anulum suum dederat Perdiccae.
Alexander, when dying, had given his ring to Perdiccas.

Both the present participle and the perfect participle passive are largely used with substantives in the ablative of attendant circumstances or ablative absolute. Examples :—

Pergit ire, **sequentibus paucis**, in tabernaculum Metelli.
Followed by a few (a few following) he went straight to the tent of Metellus.
Germanico bello confecto, Caesar statuit sibi Rhenum esse transeundum.
The German campaign being finished, Caesar determined that it was necessary for him to cross the Rhine.

A participle and substantive are often used to express the abstract idea of an action performed upon the substantive, as in :—

Dicitur **insula capta** illum magno dolore affecisse.
The capture of the island is said to have caused him deep vexation.
Post Ciceronem mortuum.
After the death of Cicero.

Exercise 30

Translate into English :—

1. Ut ad bella suscipienda Gallorum alacer ac promptus est animus, sic mollis ac minime resistens ad calamitates perferendas mens eorum est. 2. Bina postea inter tot annos, tot bella, opima parta sunt spolia : adeo rara eius fortuna decoris fuit. 3. In illis quidem parandis adhibere curam, in amicis eligendis negligentes esse. 4. Experiendum autem est in ipsa amicitia. 5. Ita praecurrit amicitia iudicium tollitque experiendi potestatem.

Translate into Latin :—

1. Augustus himself was almost inconsolable after the death of Marcellus. 2. They are sending Drusus to Africa with a general promise of pardon (promising pardon to all). 3. A fierce battle was begun, attended by heavy losses on both sides. 4. It is said that he often displayed true magnanimity towards his opponents. 5. Two very trustworthy slaves were sent to Agrippa with a letter. 6. Those two famous liberators of their country died on the same night.

Key to Exercise 27

1. Who having thus possessed himself of the kingdom prepared to re-establish, with justice, laws, and morality, the new city founded by force and arms. 2. Gabii being recovered, Tarquin made peace with the nation of the Aequi, and renewed the treaty with the Tuscans. 3. Not with strength or the speed or swiftness of the body are great things accomplished. 4. The leader of the enemy being slain, he took the city at the first assault. 5. The victorious army being withdrawn thence, he himself ascended into the Capitol. 6. Good health is advantageous in that you are free from pain and perform the functions of the body.

1. Possunt aliquando oculi non fungi suo munere. 2. Te omni honore indignissimum iudicat. 3. Vir patre, avo, maioribus suis dignissimus. 4. Quousque humi defina tua mens erit? 5. Id quidem domi est. 6. Horum virtus fuerat domi militiaeque cognita.

Key to Exercise 28

1. Who is this man that I see before the temple at this time of the night? 2. He chose rather to be involved in these waves and tempests to extreme old age than to pass his life most pleasantly in that tranquillity and leisure. 3. The matter is in a bad way when what ought to be achieved by virtue is attempted by means of money. 4. As it not only ought to be so but even must be so. 5. From these things it may be understood what a safeguard to mankind is in fortitude of mind. 6. Ask him to come here. Be it so.

1. Cupio equidem et jampridem cupio, Alexandriam visere. 2. Rusticus expectat dum defluat amnis. 3. Hic quantum in bello fortuna possit cognosci potuit. 4. Huius enim facta, illius dicta laudantur. 5. Partem tertiam incolunt qui suorum lingua Celtae appellantur. 6. Senatui placuit C. Cassium proconsulam provinciam Syriam obtinere.

E. A. B.

FRENCH.—XXXI

The present participle is invariable when it is a true participle, that is, when it expresses continuous action, as in—

Des hommes marchant,	*Men walking.*
J'ai vu les vents grondant sur ces moissons superbes,	*I have seen the winds roaring over those superb harvests.*
Ces hommes, prévoyant le danger, s'enfuirent,	*Those men, foreseeing the danger, fled.*
En écrivant, en lisant,	*In writing, in reading.*

When used attributively to express the qualities, condition, or situation of a substantive, it is known as a verbal adjective, and agrees in gender and number with the substantive, as in—

Une femme obligeante est aimée de tout le monde,	*An obliging woman is beloved by everyone.*
Il n'y a que les natures aimantes qui soient propres à l'étude de la nature,	*Only affectionate natures are fit for the study of nature.*

But—

Une femme obligeant tout le monde est généralement aimée,	*A woman obliging every one is generally loved.*
Les natures aimant la solitude aiment généralement l'étude,	*Natures loving solitude are in general fond of study.*

Compare the following :—

On voyait des débris flottant vers la côte,	*Some debris was seen floating towards the coast.*
Calypso aperçut des débris flottants sur la côte.	*Calypso saw some debris floating near the coast.*

The present participle can never be used in French like the English verbal noun in **-ing**, but a noun or an infinitive must be used, thus—

Le jeu est une passion terrible,	*Gaming is a terrible passion.*
Dormir est nécessaire à la santé,	*Sleeping is necessary to health.*

It may also be possible to render the English verbal noun by means of a periphrasis, thus—

Ils entrérent sans que je les visse,	*They came in without my seeing them.*

When the English verbal noun has an object, and is the subject of some part of the verb *to be*, it is usually expressed in French by the infinitive preceded by **de,** as in—

Il est méritoire de bien faire cela,	*Doing that well is meritorious.*
C'est le devoir d'un bon fils d'aimer ses parents,	*Loving his parents is the duty of a good son.*

When the present participle refers to the subject of the main verb, and expresses simultaneous action, it is usually preceded by the preposition **en,** thus—

Il me parlait tout en écrivant,	*He spoke to me while he was writing.*

When the English present participle refers to the object of the verb to which it is joined, it must be rendered into French by means of an infinitive or a relative clause, thus—

I see her working,	Je le vois travailler.
She perceived a child coming towards her,	Elle aperçut un enfant qui venait à elle.

The Past Participle used with the auxiliary **être** agrees, like an adjective, in gender and number with the subject, as in—

Elles sont bien reçues de tout le monde,	*They are well received by everyone.*
Votre sœur est partie ce matin,	*Your sister went away this morning.*
Ma sœur s'est repentie,	*My sister has repented.*
Leurs chevaux se sont cabrés,	*Their horses have reared.*

The past participle used with the auxiliary **avoir** agrees with the object of the verb only when the object precedes the auxiliary, as in—

Les maisons que nous avons achetées,	*The houses that we have bought.*

But—

Nous avons acheté des maisons,	*We have bought some houses.*
J'ai reçu votre lettre,	*I have received your letter.*

With impersonal verbs conjugated with **être** the participle agrees with the grammatical subject **il,** and is invariable, as in—

Il est arrivé des étrangers,	*Some foreigners have arrived.*
Il est survenu un fracas terrible,	*A terrible uproar ensued.*

Impersonal verbs conjugated with **avoir** having no direct object, their past participle is invariable, as in—

Il a plu, il a tonné,	*It has rained, it has thundered.*
Mes amis ont parlé ; leurs cœurs sont attendris,	*My friends have spoken ; their hearts are moved.*

With reflexive verbs, the auxiliary **être** taking the place of **avoir,** the past participle is governed by the same rule as if it were conjugated with **avoir,** agreeing with the direct object when that precedes the verb, thus—

Ces dames se sont flattées,	*Those ladies have flattered themselves.*
Les histoires qu'ils se sont racontées,	*The stories that they told each other.*
Les chevaux que mon ami s'est donnés,	*The horses that my friend has given himself.*

But—

Votre sœur s'est acheté de belles robes,	*Your sister has bought herself some handsome dresses.*

The past participle **fait** when followed by an infinitive, and **dû, voulu, pu,** when an infinitive is understood after them, are invariable, thus—

La maison qu'il a fait bâtir est belle,	*The house he has had built is beautiful.*
Il a obtenu toutes les grâces qu'il a voulu (obtenir),	*He obtained all the favours he wished (to obtain).*
Il n'a pas fait tous les efforts qu'il a pu (faire),	*He has not used all the efforts he could (use).*
Elle n'a pas rempli tous les devoirs qu'elle aurait dû (remplir),	*She has not fulfilled all the duties that she ought (to have fulfilled).*

When, however, no infinitive is understood after **dû** or **voulu,** they agree with their object, thus—

On lui a accordé toutes les faveurs qu'il a voulues,	*They granted him all the favours he wanted.*
Il m'a payé les sommes qu'il m'a dues si longtemps,	*He has paid me the sums he owed me so long.*

When the phrase **le peu** means a small

quantity, the participle agrees with the noun following **le peu**, thus—

Le peu d'affection que vous lui avez témoignée lui a rendu le courage, — *The little affection which you have shown him has restored his courage.*

When **le peu** means lack or absence of the thing referred to, the participle remains invariable, thus—

Le peu d'affection que vous lui avez témoignée l'a découragé, — *The lack of affection that you have shown him has discouraged him.*

The past participle is, of course, always variable when employed as an adjective, as in—

des livres imprimés, *printed books.*
des femmes bien abattues, *very dejected women.*

VOCABULARY

s'arroger, *to arrogate to oneself.*
l'azur, m., *the azure.*
le bûcher, *the pile.*
la cendre, *ash, cinders.*
la chanson, *the song.*
coûter, *to cost.*
un droit, *a right.*
émousser, *to blunt.*
éteindre, *to extinguish.*
la harangue, *the oration.*
l'inimitié, *enmity.*
injurier, *to insult, abuse.*
la lampe, *the lamp.*
la larme, *the tear.*
le mécontentement, *discontent.*
méprendre, *to mistake, misunderstand.*
ouvert, *open.*
prévenant, *obliging, anticipating.*
sourd, *quiet, concealed.*
suspendre, *to suspend, hang.*
l'urne, f., *the urn.*
valoir, *to cost.*
verser, *to pour.*

Exercise 59

1. Comme une lampe d'or dans l'azur suspendue, la lune se balance aux bords de l'horizon. 2. Ses rayons affaiblis dorment sur le gazon. 3. Etant fatigué, je vais me coucher. 4. Les droits que votre sœur s'est arrogés. 5. Je les en ai avertis. 6. Vous les en avez informés. 7. Plus il a eu d'ennemis, plus il en a vaincus. 8. Le peu de fortune que j'ai acquise me suffit. 9. Je ne regrette pas les peines que cet ouvrage m'a coûtées. 10. Les honneurs que sa conduite lui a valus. 11. Les inimitiés sourdes et cachées sont plus à craindre que les haines ouvertes et déclarées. 12. Le fer est émoussé; les bûchers sont éteints. 13. La vertu obscure est souvent méprisée. 14. Quand il vit l'urne où étaient renfermées les cendres d'Hippias, il versa un torrent de larmes. 15. Les meilleures harangues sont celles que le cœur a dictées. 16. C'est la verité elle-même qui lui a dicté ces belles paroles. 17. Les dieux ont attaché presque autant de malheurs à la liberté qu'à la servitude. 18. Ils se sont injuriés. 19. Les privilèges que la reine s'était arrogés excitaient un mécontentement général. 20. Il y avait un an que le prince s'était arrogé ces droits.

Exercise 60

1. Is my cousin as obliging as yours? 2. She is as obliging, and much more charming than mine. 3. Are your children obliging? 4. My children, anticipating all my wants, leave me nothing to desire. 5. Read very attentively the following pages. 6. Those young ladies, following their mother's example, applied themselves to reading. 7. What have you let fall? 8. I have dropped my pen; the point of it was blunted. 9. Learning to swim is useful. 10. Eating is necessary to all the animals. 11. My mother is gone out. 12. My aunts have arrived. 13. Their sons have become tall. 14. Her grandmother died yesterday. 15. I have received your letter. 16. That woman has made herself unhappy. 17. The indiscretion with which we have reproached ourselves. 18. Here is the lady whom you heard sing. 19. Here is the song that you heard sung. 20. You heard a lady sing; here she is.

Key to Exercise 52

1. Le duc doit à la bienveillance dont l'honorait la feue reine, les bonnes grâces de l'empereur. 2. Il était nu-tête, les pieds chaussés de petites sandales. 3. Une demi-heure après avoir quitté le vaisseau, je foulai le sol américain. 4. Accoutumez vos enfants à demeurer été et hiver, jour et nuit, toujours tête-nus. 5. Opimius paya la tête de Caius Gracchus dix-sept livres et demie d'or. 6. Beaucoup de personnes. 7. Il me reste peu de livres qui m'ont été donnés. 8. Les méchants ont bien de la peine à demeurer unis. 9. Je ne vous ferai pas de reproches. 10. L'on ne dit jamais que l'on n'a point d'esprit. 11. Le cœur, l'esprit, les mœurs, tout gagne à la culture. 12. L'histoire ancienne et la moderne. 13. Les philosophes anciens et les modernes. 14. À ces mots il lui tend le doux et tendre ouvrage. 15. On distinguait parmi les nobles les palatins ou gouverneurs des provinces.

Key to Exercise 53

1. That man is not pleased. 2. That man is not pleased with his son. 3. It is more glorious to conquer oneself than to conquer others. 4. That is not easily done. 5. One must be charitable to the poor and civil to everyone. 6. He who lives content with little possesses all things. 7. There is no Roman who is not desirous to give you his hand. 8. Ignorance is always ready to admire itself. 9. Insensible to life, insensible to death, he does not know when he is awake or when asleep. 10. That pure air, those lawns, that changing vault. 11. Here everything pleases the heart and charms the eye. 12. My father, mother, and sisters have arrived. 13. I see that my arm is swelling. 14. Every week I write (letters) to my brother, and hear (receive them) from him. 15. Cinna and Carbo, a lieutenant of his, encamped on the banks of the Tiber. 16. That book is well printed; its paper is excellent. 17. I live in the country; its charms are without number. 18. Paris is a remarkable city; foreigners admire the beauty of its buildings. 19. Leo the tenth. 20. Chapter ten.

Key to Exercise 54

1. La dixième année. 2. Livre sixième, chapitre dixième. 3. Ces langues sont riches; j'en admire les beautés. 4. Ces langues ont leurs beautés. 5. La campagne a ses agréments. 6. Vous retombez toujours dans les mêmes alarmes. 7. Les dieux eux-mêmes devinrent jaloux des bergers. 8. Ces murs mêmes, seigneur, peuvent avoir des yeux. 9. Le lion est tout nerfs et muscles. 10. Le chien est tout zèle, tout ardeur, tout obéissance. 11. Quand on est bon pour tout le monde, on ne l'est pour personne. 12. Il fut célèbre par sa doctrine, autant que par sa naissance. 13. La religion est nécessaire et naturelle à l'homme. 14. J'ai mal à la tête. 15. Charles s'est cassé le bras. 16. Ce sont les mœurs qui font la bonne compagnie. 17. Ce sont eux qui viennent. 18. Sont-ce des religieux et des prêtres qui parlent ainsi? sont-ce des chrétiens? 19. Votre père et moi, nous avons été longtemps ennemis l'un de l'autre.

E. A. B.

RUSSIAN—XIX

The Preposition

218. The following prepositions govern the Genitive :—

Безъ, *without.*
Для, *for.*
До, *up to, till, until, before.*
Изъ, *out of, from, of.*
Отъ, *of, from.*
Ра́ди, *for the sake of.*
У, *at.*
Изъ-за, *from behind, through, for.*
Изъ-подъ, *from under.*

Examples

Дѣло безъ конца́,	*it is a business without an end* (an endless business).
Для Васъ я посчита́ю дешёвле,	*for you I shall charge cheaper.*
Я э́того не зналъ до сего́ числа́,	*I did not know it till to-day.*
Я дѣлаю оборо́тъ до милліо́на рубле́й,	*I do a turnover up to a million roubles.*
Онъ заплати́лъ ве́ксель до сро́ка,	*he paid the bill before the term.*
Изъ э́того ди́ва не бу́детъ пи́ва,	(Proverb: Out of this prodigy there will be no beer), *nothing will come out of this affair.*
Получа́йте сда́чи изъ пяти́ рубле́й,	*here is your change from* (out of) 5 *roubles.*
Эта маши́на сдѣлана изъ чугуна́ и ста́ли,	*this machine is made of cast iron and steel.*
Мы получи́ли изъ Ха́рькова большо́й зака́зъ на се́рпы и ко́сы,	*we have received a big order from Charkoff for sickles and scythes.*
Мы получи́ли отъ Бра́тьевъ Го́лубовыхъ запро́съ на тока́рные станки́,	*we have received an inquiry from Golubovy Brothers for lathes.*
Ра́ди Васъ я гото́въ сдѣлать всё, что хоти́те,	*for your sake I am prepared to do everything you like.*
У него́ нѣтъ дѣла,	*he has no business.*
Изъ-за глу́пости не сто́итъ перегова́риваться,	*it is not worth while to have arguments for a trifle* (arguing over).
Онъ подня́лся изъ-за конто́рки,	*he got up from behind the counter.*
Изъ-за Ва́шей оплошности я потеря́лъ хоро́шее дѣло,	*through your negligence I have lost a good bargain* (transaction).
Изъ-подъ земли́ добыва́емъ всѣ на́ши бога́тства,	*from beneath the earth* (under the soil) *we derive all our riches.*

219. The preposition къ, *to*, governs the Dative.

Example

Обрати́тесь къ управля́ющему,	*apply to the manager.*

220. The following govern the Accusative :—

Сквозь, *through.*
Про, *for, of* (about).
Че́резъ, чрезъ, *through, over, in* (after).

Examples

Я едва́ проби́лся сквозь толпу́,	*I hardly made my way through the throng.*
Чрезъ Ва́шу ме́дленность мы потеря́ли по́ѣздъ,	*through your slowness we have lost the train.*
Насъ перевезли́ на ло́дкахъ чрезъ рѣку́,	*we have been conveyed in canoes across the river.*
Я вамъ заплачу́ че́резъ мѣсяцъ,	*I shall pay you in a month.*
Берегі́ де́нежку (½ farthing) про чёрный день,	*save the penny for a rainy day.*
Весь го́родъ толку́етъ про Васъ,	*the whole town is talking about you.*

221. The preposition надъ, *over, on, at,* governs the Instrumental.

Examples

Онъ имѣетъ надъ нимъ большу́ю власть,	*he exercises a great power over him.*
Онъ сжа́лился надъ нимъ,	*he had pity on him.*
Онъ насмѣха́ется надъ Ва́ми,	*he laughs at you.*

222. The preposition при, *at, near by,* governs the Prepositional.

Examples

При на́шемъ дѣлѣ имѣется мастерска́я,	*there is a workshop at our business.*
Я напо́ню ему́ объ э́томъ при пе́рвомъ слу́чаѣ,	*I shall mention it to him at the first opportunity.*

223. The preposition ме́жду, *between, among,* governs the Genitive when answering the question *where to?* and the Instrumental in answer to the question *where?*

Examples

Мы вы́слали циркуля́ры ме́жду странъ,	*we sent out circulars amongst* (to various) *countries.*
Ме́жду э́тими двумя́ сорта́ми пря́жи есть больша́я ра́зница,	*there is a great difference between these two sorts of yarns.*

224. The preposition за, *for, behind, by, in, because of, after, to, through, on account,* governs—

I. The Accusative in answer to the questions *why? for how much? for whom? for what? where to? by what? in what time? to what?*

II. The Instrumental in answer to the questions *where? sending for whom or what? because of what? through what? after what? on whose behalf or account? to whose debit?*

III. The Nominative when it comes after the Pronoun что, and means *what a!* or *why is there a?*

Examples

I

Прика́щикъ отка́занъ отъ слу́жбы за его́ наха́льство,	*the employee is discharged* (dismissed from his employment) *for his impertinence.*

Этого но́жика не доста́нете да́же за рубль,	*you will not get this penknife even for a rouble.*
Я за Васъ стара́юсь какъ мо́жно лу́чше,	*I am trying my very best for you* (literally, I try for you the best possible).
Мы пьёмъ за Ва́ше здоро́вье,	*we drink to your health.*
Ступа́й за го́родъ,	*go out of* (= behind) *town.*
Бери́ его́ за ру́ку,	*take him by the arm.*
За оди́нъ день э́того не сдѣлаешь,	*you cannot* (will not) *do it in a day.*
Бери́тесь за рабо́ту,	*take to work!*

II

Мы живёмъ за го́родомъ,	*we live out of* (behind the) *town.*
Пошли́те за носи́льщикомъ,	*send for a porter* (carrier).
Я посла́лъ за почто́выми ма́рками,	*I have sent for postage stamps.*
За рублёмъ дѣло не разойдётся,	*the deal will not be lost because of one rouble.*
Дѣло ру́хнуло за неспосо́бностью хозя́ина,	*the business fell down* (went to pieces) *through the owner's incapacity.*
Онъ мнѣ посыла́етъ катало́гъ за катало́гомъ,	*he sends me catalogue after catalogue.*
За Ва́ми счита́ется ещё оста́токъ въ пятьсо́тъ рубле́й,	*there is still a debit balance on your account for* 500 *roubles.*

III

Что за чу́дный рису́нокъ!	*what a wonderful design!*
Что за пре́лесть!	*how charming!*
Что за суматоха?	*why such an upheaval* (a confusion)?

225. The prepositions подъ, *under*, and пе́редъ, предъ, *before*, govern the Accusative in answer to the question *where to?* and the Instrumental in answer to the question *where?*

Examples

Возьми́ посы́лку подъ мы́шку,	*take the parcel under your arm* (literally, armpit).
Что тамъ несёшь подъ па́зухой?	*what are you carrying there under the arm?*
Ему́ придётся за́втра предста́ть предъ судъ,	*he will have to appear tomorrow in the court.*
Онъ былъ обвинёнъ пе́редъ судо́мъ въ моше́нничествѣ,	*he was indicted before the court for fraud* (roguery).

The Prepositions will be dealt with further in Lesson XXI.

Reading Exercise

СТАТЬЯ́ ДЛЯ ЧТЕ́НІЯ

A Manchester Shipping House (*continued*)

1. After sending off the speculation patterns, we advertised for a traveller.

Ма́нчестерская Экспо́ртная Конто́ра

(Продолже́ніе)

1. По́слѣ вы́сылки спекулятивныхъ образцо́въ мы объяви́ли въ га́зетахъ о томъ, что намъ тре́буется вояжёръ.

2. We call speculation patterns, the offers we make of patterns of goods likely to bring orders from any particular market.

2. Мы называ́емъ спекулятивными образца́ми предложе́нія, кото́рыя мы дѣлаемъ по обра́зчикамъ това́ровъ, въ надёждѣ, что они́ привлеку́тъ заказы съ люба́го специа́льнаго ры́нка.

3. Several energetic young men, knowing languages and the requirements of the different markets, replied to our advertisement.

3. Нѣсколько энерги́чныхъ молоды́хъ люде́й со зна́ніемъ иностра́нныхъ языко́въ и потре́бностей ра́зныхъ ры́нковъ отозва́лись на на́ше объявле́ніе.

4. We chose the most suitable man among these applicants and engaged him at a fair salary.

4. Мы избра́ли наибо́лѣе подходя́щаго для насъ изъ э́тихъ проси́телей и заангажи́ровали его́ на весьма́ хоро́шемъ жа́лованіи.

5. Our principle has always been to pay a good amount for work done, in order to secure the best our employee can give and to induce him to stay with us.

5. На́шимъ принци́помъ всегда́ бы́ло плати́ть ще́дро за ока́занныя услу́ги, да́бы нашъ слу́жащій (or служа́щій) стара́лся для насъ какъ можно лу́чше и имѣлъ охо́ту продолжа́ть свою́ слу́жбу у насъ.

6. Our traveller at once began to get together his pattern sets and to draw up his sale prices.

6. Нашъ вояжёръ сра́зу при́нялся за собира́ніе свои́хъ колле́кцій образцо́въ и составле́ніе свои́хъ прода́жныхъ цѣнъ.

7. Before his departure, we procured letters of introduction and letters of credit for him.

7. Пе́редъ его́ отъѣздомъ мы доста́ли для него́ рекоменда́тельныя пи́сьма и аккредити́вы.

8. In this way he could obtain a good footing with the firms likely to prove good customers, and was also able to supply his financial needs abroad in the different cities he had to visit.

8. Таки́мъ о́бразомъ ему́ дана́ была́ возмо́жность достиже́нія лёгкаго до́ступа къ фи́рмамъ, долже́нствовавшими по разсчёту стано́виться хоро́шими кліе́нтами, и пополне́нія свои́хъ де́нежныхъ нуждъ заграни́цей въ тѣхъ ра́зныхъ города́хъ, кото́рые ему́ приходи́лось посѣща́ть.

9. Meanwhile, we received various inquiries and orders from the houses to which we had made offers directly.

9. Тѣмъ вре́менемъ мы получи́ли мно́жество запро́совъ и зака́зовъ отъ тѣхъ домо́въ, кото́рымъ мы сдѣлали безпосре́дственныя предложе́нія.

10. We had already made contracts with various grey manufacturers in staple lines.

10. Къ тому́ вре́мени мы уже́ заключи́ли догово́ры съ ра́зными фабрика́нтами на главне́йшіе сорта́ суро́выхъ матери́й.

11. This arrangement rendered it possible for us to place the lines at a remunerative price to ourselves.

12. We considered ourselves very lucky to make a nice profit on our first transactions, and we allowed the clients to share in our good fortune in some cases by reducing our price for them.

13. When the maker had delivered the goods, we examined them carefully to see that they agreed in design, quality, and finish with the order.

14. If there were any discrepancies we claimed compensation or rejected the goods.

15. In some instances we sent out faulty goods on the guarantee of the manufacturer to compensate us for any claims that might be made by the consignees.

16. Certain goods were examined in the piece lap by lap to discover what are called "jobs," i.e. defects.

11. Подо́бный о́бразъ де́йствія сде́лалъ для насъ возмо́жнымъ законтрактова́ть това́ръ по при́быльнымъ для насъ це́намъ.

12. Мы счита́ли себя́ о́чень счастли́выми, получи́вши хоро́шій бары́шъ съ на́шихъ пе́рвыхъ опера́цій, и мы допусти́ли на́шихъ покупа́телей къ соуча́ствованію въ на́шемъ до́бромъ сча́стьи въ не́которыхъ слу́чаяхъ, низводя́ на́ши це́ны для нихъ.

13. Когда́ фабрика́нтъ доставля́лъ това́ръ, мы его́ тща́тельно разсма́тривали, слѣдя́ за тѣмъ, что́бы онъ согласова́лся съ зака́зомъ въ рису́нкѣ, ка́чествѣ и отде́лкѣ (аппрету́рѣ).

14. Е́сли обнару́живались непра́вильности мы тре́бовали вознагражде́нія и́ли отка́зывались отъ прия́тія това́ра.

15. Въ не́которыхъ слу́чаяхъ мы высыла́ли това́ръ съ недоста́тками подъ гара́нтіей отъ фабрика́нта, что онъ удо летвори́тъ насъ за вся́кія прете́нзіи, кото́рыя получа́тели това́ра предъя́вятъ къ намъ.

16. Не́которые това́ры разсма́тривались въ куске́, загиба́ть за загиба́ть, съ це́лью обнаруже́нія, нѣтъ ли тамъ поро́ковъ и́ли, что называ́ется, бра́ка.

Key to Exercise 1

1. What are you doing now? 2. I check your invoice. 3. What has your friend got? 4. He has a drapery business. 5. When do you work? 6. I am continually working. 7. When the Russian rouble falls, we are losing much. 8. Why do they blush? 9. We don't really understand. 10. Whom do you know here? 11. We know here the manufacturer B. and the engineer D. 12. How dares he insult the customer? 13. I despise the lazy man. 14. The book-keeper is preparing his balance-sheet. 15. The strike causes a stagnation in business. 16. The master is buying an automobile. 17. We look through the ledger. 18. I am writing out a receipt. 19. We have the honour of knowing your representative. 20. I am asking your opinion and advice.

Key to Exercise 2

1. Я умѣю чита́ть по-ру́сски. 2. Покупа́тель обѣща́етъ но́вый зака́зъ. 3. Мы провѣря́емъ кассову́ю кни́гу. 4. Хозя́инъ просма́триваетъ дне́вникъ. 5. Фабрикантъ намъ предлага́етъ свой това́ръ. 6. Они́ одобря́ютъ на́шу це́ну. 7. Ста́чка причиня́етъ намъ убы́токъ. 8. Мы конча́емъ на́шу работу. 9. Покупа́ю пишу́щую маши́ну. 10. Она́ име́етъ шве́йную маши́ну. 11. Почему́ не удовлетворя́ете покупа́теля? 12. Вы забыва́ете, что франкъ тепе́рь па́даетъ. 13. Мы ре́дко гуля́емъ. 14. Приготовля́ю но́вую колле́кцію. 15. Я лишь спра́шиваю одно́ сло́во. 16. Что означа́етъ э́то сло́во по-англи́йски? 17. Хозя́инъ подпи́сываетъ письмо́. 18. Почему́ Вы закрыва́ете Гла́вную кни́гу? 19. Онъ открыва́етъ дверь. 20. Я закрыва́ю дверь.

Key to Exercise 3

1. We meet the buyer to-day. 2. Our agent knows Russia well. 3. We occupy the whole first floor. 4. The customer wants to know the price of the goods. 5. What do you buy now? 6. Our Russian guest understands English very well. 7. We reply in Russian. 8. Your representative visits us every year.

Key to Exercise 4

1. Я не отправля́ю това́ра сего́дня. 2. Нашъ гла́вный прика́щикъ тепе́рь выполня́етъ весь Вашъ зака́зъ. 3. Покупа́тель о́чень ува́жаетъ на́шу фи́рму. 4. Принима́емъ Ва́ше предложе́ніе. 5. По́шлина превыша́етъ це́ну това́ра. 6. Вы покупа́ете това́ръ о́чень де́шево.

Key to Exercise 5

1. I recognise the value of the goods by the feel. 2. We travel very often through Russia. 3. Do you like the Russian people? 4. Yes, I like them very much for their candour. 5. On the Director's instruction the correspondent directs the letter to the agent at his new address. 6. Do you already speak Russian fluently? 7. In accordance with the customer's request we are packing his goods very carefully. 8. Through the packer's carelessness many (much) of the goods very often get (gets) lost on the road to the place of destination. 9. I am sending off the parcel to the lady customer by post. 10. I believe every word of his tale. 11. What do you say? 12. What tales are you telling me there? 13. The French customer praises very much the quality of our goods, and thanks us for the accurate execution of his order. 14. Is it true that you are building a new house? 15. No, this is an untruth (not true). I do not build a house, but I am rebuilding the factory. 16. Where are you hurrying to? 17. I am hurrying to the (railway) station. 18. How do you like my office? 19. I am interested to know whether I am liked by the principal. 20. I am earning much, but I do not save any money.

Key to Exercise 6

1. Ку́рите ли Вы папиро́ску? 2. Да, я курю́ о́чень мно́го. 3. Говори́те ли Вы пла́вно по-англи́йски? 4. Я не говорю́ по-англи́йски мно́го. 5. Почему́ Вы ста́вите э́тотъ вопро́съ? 6. Я не ста́влю вопро́са. 7. Что Вы бо́льше лю́бите, ко́фе и́ли чай? 8. Я люблю́ бо́льше чай. 9. Какъ Вы посыла́ете Ва́шему а́генту деньги? 10. Я посыла́ю ему́ де́ньги по по́чтѣ, а иногда́ по телегра́фу. 11. Почему́ Вы такъ торо́питесь? 12. Я тороплю́сь домо́й, потому́ что уже́ по́здно. 13. Хва́литъ ли ру́сскій покупа́тель нашъ това́ръ? 14. Да, онъ одобря́етъ ка́чество на́шего това́ра. 15. Какъ Вы познаёте досто́инство това́ра? 16. Мы познаёмъ досто́инство това́ра по осмо́тру. 17. Какъ Вамъ нра́вится на́ша торго́вля? 18. Она́ мнѣ о́чень нра́вится. 19. Кле́ймите ли Вы това́ръ? 20. Да, господи́нъ Б., я кле́ймлю това́ръ.

Key to Exercise 7

1. I seal the letter with sealing wax. 2. The master is satisfied with the caretaker. 3. We summon the traveller by a telegram. 4. I work more in winter time than in summer. 5. I complete my work in the evening. 6. We deal in flour. 7. I am interested in the business. 8. The Russian is distinguished by bravery. 9. I keep a large stock of sugar. 10. Mr. B. is considered a wealthy man. 11. What do you hear from the traveller? 12. He writes us very often. 13. The master threatens the

employee with discharge from the post. 14. Do you see that building? 15. Yes, I see. 16. What signifies the flag on the dome? 17. It signifies that England rules the sea. 18. By what does she rule it? 19. By the fleet.

Key to Exercise 8

1. Я о́чень ре́дко слы́шу жа́лобу отъ зака́зчика. 2. Ма́льчикъ ощуща́етъ (чу́вствуетъ) страхъ предъ хозя́иномъ. 3. Пако́вщикъ о́чень мно́го кричи́тъ. 4. Я смотрю́, какъ Вы рису́ете каранда́шемъ. 5. Гдѣ Вы де́ржите бага́жъ вояжёра? 6. Подъ скамьёй. 7. Онъ смо́тритъ богачёмъ. 8. Я пишу́ домо́й о́чень ча́сто. 9. Чего́ Вы и́щите? 10. Я и́щу каранда́ша. 11. Я не люблю́, что вы спо́рите съ покупа́телемъ. 12. Вопро́съ смуща́етъ фи́рму. 13. Я не интересу́юсь зака́зомъ, потому́ что не ви́жу при́были. 14. Мы торгу́емъ зерно́мъ. 15. Я владѣю имѣніемъ. 16. Онъ не владѣетъ капита́ломъ. 17. Мы конкурри́руемъ ка́чествомъ това́ра.

Key to Exercise 9

1. Our representative leaves to-day for Russia. 2. On the employee rests the duty of keeping (holding) in high esteem the honour of the firm. 3. We entirely (totally) rely on the representative. 4. I am employed (serve) in the office of Mr. B. 5. I go to office every day. 6. I see the customer once a month. 7. We act in this direction. 8. Our factory (mill, works) is situated close to D. station. 9. The traveller drags after him a great deal of luggage. 10. I am grinding the knife on a machine. 11. I keep very friendly with Mr. M. He teaches me speak Russian. 12. I beg you, do me a favour. 13. Tell me, please, what does an arshin of this cloth cost? 14. You are asking too much. 15. Don't ask so much. 16. Why are you standing? Sit down, please. 17. Thank you. I am already sitting. 18. Write the traveller and tell him to go immediately to Moscow. 19. Why don't you keep the book in the safe? 20. It is said that the firm Z. is liquidating the business.

Key to Exercise 10

1. Нашъ гла́вный прика́щикъ ѣдетъ чере́зъ мѣсяцъ въ Пари́жъ. 2. Мы имѣемъ два отдѣле́нія въ Пари́жѣ. 3. Мы посыла́емъ това́ръ въ Россію чере́зъ Гулль. 4. Не вѣрь его́ разска́зу. 5. Это сукно́ сто́итъ о́чень до́рого. 6. Я стою́ за мою́ цѣну́. 7. Скажи́ ма́льчику, пусть не кричи́тъ. 8. Мы дорожи́мъ Ва́шимъ зака́зомъ. 9. Почему́ Вы та́щите за собо́ю такъ мно́го бага́жа? 10. Не стой, сади́сь и пиши́ письмо́ къ господину Д.

Key to Exercise 11

1. I am an Englishman, she is an Englishwoman. 2. I like soldiers and children. 3. The Englishmen have many friends. 4. We were many times in Russia. 5. Hush, children! 6. Let us work. 7. He goes without boots. 8. The masters looked through the accounts. 9. The expenditure exceeded the income. 10. The agents sent orders.

Key to Exercise 12

1. Мы англича́не. 2. Слы́шимъ голоса́. 3. Они́ покупа́ли. 4. Учителя́ имѣютъ глаза́. 5. Ма́льчики говори́ли пра́вду. 6. Молчи́те, друзья́. 7. Я встрѣча́лъ мно́го покупа́телей. 8. Въ конто́рѣ стоя́ли сту́лья. 9. Пусть они́ рабо́таютъ. 10. Мы зна́ли э́тихъ люде́й.

Key to Exercise 13

1. We require at once five hundred pairs of boots. 2. Under separate cover we are sending you our price list with the lowest prices. 3. We have just received an order for a hundred dozen shirts. 4. We are willing to wait five weeks. 5. We herewith enclose the bill of lading for the fifty barrels of oil (or butter). 6. We have discovered in your invoice a couple of mistakes. 7. I hasten to apologise for the mistakes. 8. Your account is entered in the books correctly. 9. I am remitting to you herewith a corrected invoice. 10. I confirm the receipt of your letter, and most humbly thank you for the kind inquiry. 11. We shall wire to you to-morrow again. 12. Herewith we confirm our telegrams. 13. I am doing the thing with both hands.

Key to Exercise 14

1. Our cloths are going in all states (countries). 2. I do not approve of these actions. 3. It is a pity that you do not reckon with the circumstances. 4. I could not send off the goods before. 5. Do not use sarcastic expressions in letters. 6. May I use your telephone? 7. With pleasure. Use it as much as you please. 8. Who conducts the business in your absence? 9. My brother then administers (to) the affairs. 10. Can you give me some information about the firm D.? 11. We have no connections with this firm. 12. Goods are sold by the appearance. 13. The properties of paper are numerous. 14. Do not trust (to) denunciations. 15. Why do you not go for (= to bring) tea? 16. I went for it. 17. Where do you live? 18. We still live in the same street.

Key to Exercise 15

1. Мы до́лгое вре́мя жи́ли въ Пари́жѣ. 2. Я ви́дѣлъ его́, когда́ онъ шёлъ на би́ржу. 3. Нашъ магази́нъ имѣетъ пять око́нъ. 4. На́ши су́кна не имѣютъ пя́тенъ. 5. Веди́те Ва́ши дѣла че́стно и благоро́дно. 6. Куда́ Вы шли сего́дня у́тромъ? 7. Я шёлъ за ча́шкой ко́фе. 8. Гдѣ моё пальто? 9. Оно́ оста́лось въ ландо́. 10. Не полага́йся на чудеса́. 11. Мы живёмъ про́сто и скро́мно. 12. Я не люблю́ ко́лкихъ выраже́ній. 13. Я получа́ю свѣдѣнія пря́мо изъ Аме́рики. 14. Мы не мо́жемъ удовлет. воря́ть всѣмъ жела́ніямъ. 15. Мы имѣемъ отдѣле́нія въ нѣсколькихъ мѣста́хъ. 16. Онъ по́льзуется въ обществѣ больши́мъ почётомъ. 17. Благодарю́ Васъ за сообще́нія. 18. Почему́ не выполня́ете приказа́ній. 19. Вы ведёте Ва́ши дѣла́ безъ поря́дка. 20. Это не Ва́ше дѣло.

Key to Exercise 16

1. How was my silk selling at your place? 2. It was simply torn out from the hands (snatched from one's hands). 3. Talk with the tongue what you like, but do not use your hands (Russian: do not give freedom to the hands). 4. I was waiting for your coming over an hour. 5. I beg your pardon, I was very busy. 6. Do not praise in the presence (Russian—in the eyes), do not scold behind the back (Russian—behind the eyes). 7. The clock strikes midnight. 8. Does Petrograd often send you orders? 9. Yes, our goods are selling there very quickly. 10. Please reply the soonest possible: the matter is very urgent. 11. It is said that B. Brothers have stopped payment. 12. It cannot be. It is a lie. 13. You will admit that they have suffered much through the fire. 14. Well, what harm is there? They will get the insurance. 15. But meanwhile they are losing trade. 16. No matter (harm). Let them have a bit of a rest. 17. Your newest (latest) velveteens are excellent. 18. Judging by the patterns one may reckon on a profitable sale. 19. Can you hand (give) over to me the sole representation for the whole of Russia? 20. The development of our business (affairs) does not allow us to concentrate our Russian interests in single hands.

Key to Exercise 17

1. Я несу́ на плеча́хъ тяжёлое бре́мя. 2. Онъ по́льзуется хоро́шимъ и́менемъ. 3. Дѣти шумя́тъ. 4. Почему́ не ѣдите? 5. Я не хочу́, я не могу́, я не ѣмъ мя́са. 6. Почему́ не идёте въ теа́тръ? 7. У меня́ нѣтъ вре́мени. 8. Пьёте ли Вы вино́? 9. Я не пью никаки́хъ винъ. 10. Когда́ Вы ѣдете въ Швейцарію? 11. Я ду́маю ѣхать туда́ чере́зъ мѣсяцъ. 12. Кто тамъ побѣтъ? 13. Это мои́ прика́щики немно́жко ба́луются. 14. Ра́звѣ имъ не́чего дѣлать? 15. Это ихъ обѣденное вре́мя. 16. Куда́ бѣжи́тъ ма́льчикъ: зови́ его́ наза́дъ. 17. Онъ не хо́четъ верну́ться. 18. Я чита́ю и пишу́ безъ очко́въ. 19. Жду пи́семъ изъ Москвы́. 20. На́ше дѣло растётъ со дня на́ день. A. C.

ITALIAN.—VI

The Verb.—Most regular verbs, except those given in Lesson V., insert **isc** between the stem and the termination in the singular and in the 3rd person plural of the present indicative, imperative and present subjunctive, as :—

Finire, *Present Indicative**

Sing.	*Plur.*
Finisco	finiamo.
Finisci	finite.
Finisce	finíscono.

There are, however, a few verbs in **ire** which may either take or omit this **isc**, viz. :—

aborrire, *to abhor.*
applaudire, *to applaud.*
assorbire, *to absorb.*
compartire, *to divide.*
inghiottire, *to swallow.*
lambire, *to lap, lick.*
mentire, *to tell lies.*
muggire, *to low, bellow.*
nutrire, *to nourish.*
partire, meaning *to divide.*
pervertire, *to pervert.*
plaudire, *to applaud.*
ruggire, *to roar.*
sdrucire, *to unsew.*
sovvertire, *to subvert.*

Miscellaneous examples :—

Preferisco dargli questa qualità.	*I prefer to give* (to) *him this quality.*
Mi dice che l'acqua bolle adesso.	*He tells me that the water is boiling now.*
Volete dirmi dove si trova l'indirizzo ?	*Will you tell me* (say to me) *where the address is* (where finds itself the address) ?
Avete venduto loro tutta la merce ?	*Have you sold them all the goods ?*
Vendéndola loro tutta, non ci rimane niente.	*By selling them* (la = la merce) *all to them, nothing remains for* (to) *us.*
Vi spieghiamo (from spiegare) l'affare.	*We explain the matter to you.*

Note.—With verbs in **-care** and **-gare**, **h** is inserted before **e** and **i** to keep the **c** or **g** hard.

Mi ha scritto che non finisce oggi l'estratto del vostro conto.	*He has written me that he is not finishing the extract of your account to-day.*
Quel signore è molto sgarbato nelle sue maniere, ma non ne fate (neg. imper.) caso.	*That gentleman is very impolite in his manners, but take no notice of him* (of them) (lit., do not make case of it, him, them).

Ne is used like the French **en**, meaning "some," "of it," "of them," of what has been mentioned.

Mi, **ti**, **si**, **ci**, **vi**, dative, change the **i** into **e** before the accusatives **lo**, **la**, **li**, **le**, **ne**. We give one example :—

Me lo dice. *He says it to me.*

When two conjunctive pronouns occur together, the indirect object precedes the direct, as :—

Ce lo dà, *he gives it to us.* Dátemeli, *give them to me.*

Ci and **vi**, referring to things, mean *at* (*to, for, in, about, of*), *it*, or *them*, as **Non ci** (or **vi**) **penso**, *I do not think of it.* **Pensare a** = *to think of* (literally, *to*) ; **Pensarne (pensare di)** = *to think of it* (form a judgment concerning it).

Ci, **vi**, and **ne**, as adverbs, mean **ci**, *here ;* **vi**, *there ;* but they are used indifferently ; **ne** is *from there.* Mi ci reco spesso (sovente), *I go there often* (literally, I betake myself thither often).

Vi and **ci**, used in this way, though really adverbs, are treated as pronouns, and become **ce**, **ve**, when followed by **lo**, **la**, **li**, **le**, and **ne**.

Ne veniamo ogno giorno.	*We come from there every day.*
Ci (vi) siamo entrati insiéme.	*We have entered there together.*
Ne usciamo generalmente alle quattro.	*We come out of it* (the office, school, church, etc.) *at four o'clock usually.*
Andáteci, e vi troverete il compratore.	*Go there, and you will find the buyer there.*
Prende gli ábiti e se (accusative) ne veste.	*He takes the clothes and dresses himself in them.*
Préndono i biglietti e se (dative) ne danno cínque	*They take the tickets and give five of them to themselves.*

Ne always follows, when used together with another conjunctive pronoun.

Ci and **vi** with the 3rd person of the verb **éssere** (sometimes **avere**) expresses the English *there to be*, as :—

Vi è, c'è, *there is* / vi sono, *there are* } French, il y **a**

Vi era, c'era, *there was* / vi érano, si érano, *there were* } French, il y avait

Non ve (ce) ne sono qui, *there are none here* ; non ce n'è qui, *there is none here*

Eccoci, *here we are* ; éccolo, *here it is* ; éccone, *here is* (are) *some* ; Ecco la léttera, *here is the letter*

Possessive Adjectives and Pronouns

Adject.	*Pron.*	*Mas. Sing.*	*Fem. Sing.*	*Mas. Plur.*	*Fem. Plur.*
My	*mine*	il mío	la mía	i miéi	le míe.
Thy	*thine*	il túo	la túa	i tuói	le túe.
His, her	*his, hers*	il súo	la súa	i suói	le súe.
Our	*ours*	il nostro	la nostra	i nostri	le nostre
Your	*yours*	il vostro	la vostra	i vostri	le vostre
Their	*theirs*	il loro	la loro	i loro	le loro.

Loro is invariable.

* The imperative and present subjunctive will be given in a later lesson.

VOCABULARY

a casa, *home.*
la tinta, *dye, colour.*
prendete (you), *take* (imp).
in questo momento, *at present.*
la corrispondenza, *correspondence.*
intiero, *entire.*
la disposizione, *disposal.*
vado, *I go.*
Roma, *Rome.*
recarsi, *to betake oneself, to go.*
vedere, *to see.*
fare caso, *to take notice.*
pensate (you), *think* (imp).
più, *any longer.*
valere, *to be worth.*
rimorchiare, *to tow.*
il rimorchio, *towage.*
saldare, *to settle, balance.*
il naufragio, *wreck.*
la dogana, *Custom House.*
l'equipagio (m.), *crew.*
la libbra, *pound* (weight).
il libro maestro, *ledger.*
il fallito, *bankrupt.*
la pena, *trouble, pain.*
valere la pena, *to be worth while.*
la menzione, *mention.*
arrivare, *to arrive.*
nove, *nine.*
portate, (you) *bring* (imperat.).
come di (or, al) sólito, *as usual.*
usare, servirsi di, *to use, make use of.*
occupato, *busy.*
altra cosa, *anything else.*
rimanere, *to remain.*
sa (he), *knows.*
fa (he), *makes.*
la lista, il listino, l'elenco, *list.*
come da elenco, *as per list.*
carta moneta, *paper money.*
il mercato rigúrita, è rigurgitante, strabocca, soprabbonda *di, the market is glutted* with.
in ristagno, *at a standstill.*

Exercise 11

Translate into English :—

1. Preferisce darci un'altra qualità. 2. Finítemi la léttera e poi andate a casa! 3. Se volete della tinta, éccone, prendétevene (take some of it for yourself). 4. C'érano molti compratori da noi ieri. 5. Non ce (ve) ne sono qui in questo momento. 6. Egli non ne fa menzione nella súa corrispondenza. 7. C'è tanto da dirvi che non so dove cominciare. 8. C'è (v'è, vi ha, ci ha—*vi ha* or *ci ha* is classical style) molto da fare. 9. Éccoci a vostra intiera disposizione. 10. Se voi ci (vi) andate, prendete un biglietto per Venezia. 11. Cosa se ne dice sulla piazza (sul mercato)? 12. Vado a Roma e ne ritorno ogni settimana. 13. Questo signore ci (vi) si reca sovente (spesso), ce lo vedo quasi tutti i giorni. 14. Vi (ci) éntrano sempre insieme. 15. Non fate caso delle maniere sgarbate di quell' uomo.

Exercise 12

Translate into Italian :—

1. Do not think of it, it is not worth while. 2. We arrive at the office at (the) nine in (of) the morning and come out of it at four o'clock in (of) the afternoon. 3. Go there and bring me them (f. pl.) as usual. 4. They buy the tickets (labels) for all the pieces and give us three hundred of them. 5. He takes the bill of exchange and makes use of it to (per) balance the account. 6. They ask us to (di) tell them where the address is. 7. Why do you not tell me that the water is boiling now? 8. Because I am so busy that I cannot think of (ad) anything else. 9. By selling all the goods to him, nothing remains for them. 10. I am explaining this matter to you in my letter of to-day. 11. Have you sold them all my consignment? 12. They are finishing the extract of our account this week. 13. He says it to me, because he knows (that) it is true. 14. I warn you that I cannot wait any longer. 15. What do you think of the quality of these goods? I think nothing of them. (Translate (*a*) as to judgment, (*b*) as to direction of thought.)

Key to Exercise 1

1. You have bought a cargo of three thousand bags of coffee. 2. Our travellers have departed yesterday. 3. When have you received (did you receive) the letters? 4. Have they sold all the coal? 5. Not yet, but they expect a consignment (delivery) of charcoal to-morrow. 6. All the bales and the cases of this cargo are already sold. 7. I (have) received yesterday a letter from a clerk of this merchant. 8. The sugars arrived (have arrived) the day before yesterday and are already sold. 9. To-day the buyers have worked all day and now are tired. 10. I also (too) am tired after so much fatigue. 11. We are certain that you are very tired. 12. I am sure that the orders received are already executed. 13. What does the customer say? He says that he has given the order for these two hundred pieces. 14. By selling the stocks now, we avoid a considerable loss. 15. We have said frankly what (that which) we know of this affair (matter, business). 16. Through buying new merchandise (goods) we have been able to make many profitable sales and to increase the custom in a remarkable (notable) manner. 17. That piece is longer than this, but is less wide. 18. The pieces are too narrow, they have been ordered in twenty-eight inches of width, therefore we cannot accept the lot (of goods). 19. We have had the pleasure to receive the advice that the consignment (of goods) arrived last week. 20. Having arrived in good state (condition), the lots of wool have made a good impression on the buyers and have been very soon sold.

Key to Exercise 2

1. Abbiamo dato gli stessi (i medésimi) órdini agli uómini che sono partiti per Londra. 2. Sono stanchi dopo la fatica che hanno avuta durante il giorno e non hanno potuto lavorare più. 3. Siamo stati nel magazzino e abbiamo comprato tutte le mercanzíe (le merci) che abbiamo potuto trovare ad un prezzo ragionévole. 4. " Éssere o non éssere " è la questione che è stata spesso (sovente) sulla bocca di molti negozianti. 5. Volete avere le merci (le mercanzíe) oggi o domani, o volete aspettare la consegna ancora due o tre giorni? 6. I colli sono partiti col vapore menzionato nella pólizza di cárico acclusa. 7. Le casse lunghe sono partite sopra un bastimento italiano direttamente per Génova. 8. Le mercanzíe (le merci) essendo pronte per lo stesso (il medésimo) vapore, le abbiamo spedite senza aspettare nuove istruzioni. 9. Le pezze corte sono destinate per un compratore che è stato qui già parécchie volte questa settimana. 10. Tutto il carbone fóssile e carbone comune sono stati caricati in un vapore che è partito l'altr'ieri destinato per Nápoli. 11. Dícono che non sono stanchi dopo tanto lavoro, ma noi stessi siamo molto stanchi e abbiamo lavorato meno di loro. 12. Comprando (avendo comprato) le esistenze la settimana scorsa, abbiamo la opportunità di fare questa settimana una véndita molto profittévole. 13. Essendo queste pezze troppo strette, dobbiamo rifiutare le merce (le mercanzíe). 14. Le léttere che abbiamo ricevute stamattina (stamane) ci hanno portato poche rimesse. 15. Ci rincresce di dovervi dire che non abbiamo ricevuto ancora le partite di lana ordinate l'anno scorso. 16. L'impressione fatta sui clienti dalla buona qualità di queste mercanzíe (merci) e notévole. 17. L'órdine per tremila sacchi di caffè è arrivato, e dopo éssere eseguito speriamo spedire le merci (mercanzíe) senza indugio. 18. Perchè non avete eseguito l'órdine che vi abbiamo dato? 19. Sono partiti iersera e sono ritornati di buon'ora stamattina. 20. Mi rincresce di dire che i clienti sono tanto (così) stanchi di queste merci che non sono disposti a (or: di) comprare le esistenze che abbiamo qui.

Key to Exercise 3

1. The students who have bought the books have already departed from London for Paris. 2. Requesting you to acknowledge (confirm) to us receipt, we beg to remain, dear Sirs, Yours truly. 3. In the expectation of your kind orders, I am, dear Sirs, Yours faithfully. 4. I have received yours (your letter) of the 19th instant, together with the new patterns of velveteens, linings, drills, and other articles. 5. The letters have left (gone) together with the patterns. 6. The forwarding-agents having written to us, it is certain that the goods have already arrived. 7. If it is possible for you, always send us the invoice with the goods. 8. These gentlemen have acknowledged to me receipt of the sending and have paid me the account at the due date (maturity). 9. We have honoured the draft which was (has been) presented to us yesterday. 10. Having honoured all our drafts, the clients have the right to expect the consignment (that is, to receive the goods) without delay. 11. They have warehoused (stored) all the packages which we have sent them till now. 12. I have seen the Englishmen who have manufactured the cloth forwarded (sent) by us to Italy. 13. He has thanked me for having executed the order at such a low price. 14. Before leaving, we visited all the customers (clients) in (of) the town (city). 15. When did the friends of the printer of the pieces stored here go out? 16. The working hours in this warehouse are too long; the employees are always tired. 17. I have worked much and have been to the theatre in order to enjoy (divert) myself a little. 18. I have told him all frankly, and I have not hidden anything from him. 19. Several (various) invitations have come to us, which we have accepted with much pleasure. 20. The printers say that they have not been able to reproduce exactly the designs ordered from them.

Key to Exercise 4

1. I nostri viaggiatori sono partiti stamattina (stamane) per Parigi, Milano, Venezia e Livorno. 2. Avendo comprato un cárico di tremila sacchi di caffè, non ho più denaro (danaro). 3. Aspéttano gli invíi (or: gl'invíi) questa settimana senza fallo. 4. Gli studenti hanno accettato le invitazioni (gl'inviti) con molto piacere. 5. Lo zúcchero non è ancora arrivato. 6. Gli anni sono passati molto rápidaménte. 7. Parliamo d'uno zúcchero (d'una qualità di zúcchero) che avete comprato l'anno scorso. 8. È un'etichetta che abbiamo vista (veduta) sovente sulle pezze di tela bianca che sono vendute in questo mercato. 9. Mi ha detto che lo studente vuol partire oggi. 10. Hanno fatto vísita ad un'importante casa (casa primaria) di esportazione. 11. Credo che gli studenti vógliono comprare questi calamái d'argento. 12. Gli invíi che sono arrivati col medésimo (collo stesso) vapore non sono stati venduti ad un prezzo ragionévole. 13. Le invitazioni (gl'inviti) sono venute (venuti) troppo tardi; non possiamo accettare invitazioni che non arrivano a tempo. 14. Hanno parlato degli amici che hanno fatto il lavoro. 15. Hanno pagato il conto? Sì, signore, l'hanno (= lo hanno) pagato questo dopopranzo (pomeriggio). 16. I nostri amici dícono che sono stanchi di tanto lavoro. 17. Avete parlato francamente, non avete nascosto niente (nulla) e avete detto la verità senza paúra. 18. Abbiamo potuto riprodurre esattamente il disegno che avete ordinato loro. 19. Gli amici dello stampatore delle pezze immagazzinate qui sono usciti. 20. Prima di uscire, scrivete una léttera a ciascuno (ad ognuno) di questi clienti. A. C.

SPANISH.—VI

The Verb.—As stated in Lesson IV (Vol. IV., p. 479), the Past Definite, the endings of which are given in Lesson V (page 30), is generally used to indicate that the action expressed took place and was finally concluded at some particular moment, as distinguished from the other past tense, called the Imperfect, which, as its name implies, denotes that the action is considered to be continuous or recurrent, without calling attention to its completion. The Imperfect, being continuous, may be interrupted by the Past Definite, which is instantaneous or limited to a definite period.

Examples

Este cliènte me visitàba càda mes (repeated action—Imperfect).
This customer visited me every month.
El me visitó àyer (completed action—Past Definite).
He visited me yesterday.

Yo enseñàba lènguas modèrnas en la escuèla (Imperfect).
I taught modern languages in the school (I used to teach, etc.).
Enseñé á V. los idiòmas que sàbe (Past Definite).
I taught you the languages that you know.

Decíamos sièmpre la mìsma còsa (Imperfect).
We always said the same thing.
¿ Vs. sièmpre hablàron con èllos ? (Past Definite).
You spoke to them for all that ?

Yo hablàba con mi amìgo cuàndo V. entró (**hablàba** denotes continuous action, i.e. Imperfect, whilst **entró** denotes completed action, i.e. Past Definite—interruption of the continuous action).
I was speaking to my friend when you entered.
Yo entràba cuàndo V. habló (**entràba**, continuous; **habló**, completed action at a particular part of the continuous action expressed by entràba).
I was entering when you spoke.

Nàda faltàba pàra completàr nuèstra felicidàd (Imperfect).
Nothing was wanting to complete our happiness.
Nàda faltó, y quedàmos tòdos satisfèchos (**faltó** and **quedàmos**, Past Definite).
Nothing was missing (on that particular occasion), *and we were* (remained) *all satisfied.*

El fabricànte producía tejìdos que después vendía (**producía**, used to produce—Imperfect).
The manufacturer produced (used to produce, *textiles which he afterwards sold* (used to sell).

Los fabricàntes produjèron tejidos que después vendièron (**produjèron** is Past Definite of **producir**, **vendièron** is Past Definite of **vendèr**).

The manufacturers produced certain goods that they sold afterwards (the production and sale are both spoken of as definite actions begun and completed in the past).

Besides **habèr,** auxiliary verb, *to have*, there is another verb **tenèr,** *to have*, used independently as a principal verb, in the sense of: "to possess something," as: **Tèngo su càrta de V.** *I have* (possess) *your letter*, as distinguished from: **He recibìdo la càrta de V.**, *I have received your letter.* It will be noticed, therefore, that while **tenèr** is used simply with an object, **habèr** helps to form compound tenses of verbs, and is consequently always followed in this sense by the past participle of the principal verb, as:—

Tenèmos el sentimiènto de participàrles á Vs. que . . .	*We regret* (have the regret) *to inform you that . . .*
He tenido mùcho gùsto en recibír su gràta fècha dos del que còrre,	*I have had much pleasure in receiving your favour of the 2nd instant* (literally, of that which runs, i.e. the running or current month).

Tenèr is conjugated as follows:—

tenèr, tenièndo, tenìdo, *to have, having, had.*

INDICATIVE

Present.	tèngo, tiènes, tiène (V.), tenèmos, tenéis, tiènen (Vs.), *I have*, etc.
Imperfect.	tenía, tenías, tenía, teníamos, teníais, tenían, *I had, was having*, or *used to have*, etc.
Past Definite.	tùve, tuvìste, tùvo, tuvìmos, tuvìsteis, tuvièron, *I had* (at a definite moment or period,) etc.
Future.	tendré, tendrás, tendrá, tendrèmos, tendréis, tendrán, *I shall have*, etc.
Conditional.	tendría, tendrías, tendría, tendríamos, tendríais, tendrían, *I should have*, etc.

Use of **ser** and **estàr.**—In Spanish there are two verbs **ser** and **estàr,** meaning *to be*, which must be distinguished in the following manner:—

Estàr is used with reference to—

(1) Being in a place.
(2) With present participle.
(3) Accidental or temporary condition (but not inherent or natural quality).
(4) Completed action.

as:—

Estàmos en el almacén (place).
We are in the warehouse.

Las Cordillèras están siempre cubièrtas de niève (state in connection with place).
The Cordilleras are always covered with snow.

Estàmos escribièndo càrtas en èste momènto (escribièndo, Present Participle).
We are writing letters at this moment.

Estàmos cansàdos (accidental or temporary condition).
We are tired.

Los géneros no están lìstos (accidental or temporary condition).
The goods are not ready.

Los bùltos están ya expedìdos (completed action).
The packages are already shipped (forwarded).

In other and in doubtful cases use **ser,** as **estàr** will readily suggest itself where required.

Ser indicates—

(*a*) A permanent characteristic or quality, origin, dignity, etc., or profession or trade, as:—

Son nuèstros clièntes (permanent characteristic or quality).
They are our customers.

El dinèro es útil (permanent characteristic or quality).
Money is useful.

Soy negociànte, y mi hermàno es profesòr (profession or trade).
I am a merchant and my brother is a professor.

Mi clièntе es Chilèno (origin).
My customer is a Chilian.

(*b*) **Ser** serves to form the Passive Voice, as:—

Son escrìtas las càrtas por nuèstro dependièntе (son escrìtas, Passive Voice, i.e. suffering the action of writing).
The letters are written by our clerk (viz. our clerk is in the habit of writing the letters).

Los géneros son expedìdos por diferèntes líneas de vapòres.
The goods are sent by different steamship routes (or lines).

(*c*) **Ser** is used with: **aplicàdo,** *attentive, industrious*, **diligèntе,** *diligent*, **holgazán,** *lazy*, **honràdo,** *honourable, honest*, as also before all adjectives denoting natural inclinations, likewise before: **felìz,** *happy*, **infelìz,** *unhappy*, **rìco,** *rich*, and **pòbre,** *poor*, also:

(*a*) to signify ownership, as:—

El pedìdo es nuèstro, *The order is ours.*

(*b*) With Impersonal Verbs, as:—

Es imposìble, *It is impossible.*
Es verdàd, *It is true.*

(*c*) Before a noun, even when the latter is preceded by an Article or Adjective, as:—

Son los mejòres clièntes del mùndo, *They are the best customers in* (of) *the world.*

Comparison between **ser** and **estàr** :—

Ser (= *nature*)	**Estàr** (= *state*)
Son empleàdos, *they are employees* (employed by somebody, viz. someone employs them).	Están empleàdos, *they* are (just now) *occupied, busy,* or *employed* (writing letters, packing goods, etc.).
Èstas manzànas son vèrdes, *these apples are green.*	Èstas manzànas están vèrdes, *these apples are unripe* (temporarily green).
Es buèno, *he is good* (he is a good fellow, of a good disposition).	Está buèno, *he is well* (in health).
Nuèstro amigo es vivo, *our friend is lively* (of a lively nature or disposition).	Nuèstro amigo está vivo, *our friend is alive.*

VOCABULARY

el dependiènte, *the clerk* (commercial).
divèrso, *diverse, various.*
la lèngua, *the language.*
durànte, *during.*
el secretàrio, *the secretary.*
iba (Imperf. of ir), *I* (or he, etc.), *was going.*
allí, *there.*
continuàr, *to continue.*
ni, *nor.*
¿ qué ? *what ?*
producìr (irregular), *to produce.*
después, *afterwards, after.*
después de, *after* (before a noun or object).
la fábrica, *the manufactory, mill* or *works.*
bonito, *nice, pretty.*
el capitàl, los capitàles, *the capital* (money).
la firma, *the signature.*
la fècha, *the date.*
la lètra, *the bill* (of exchange).
la fàlta de aceptación, *the non-acceptance.*
suficiènte, *sufficient, enough.*
trabajàr, *to work.*
cansàdo, *tired.*
listo, *ready.*
el vapòr, *the steamer.*
capàz, *capable.*
el ejército, *the army.*
el colòr, *the colour.*
naturàl, *natural.*
la nòche, *the night.*
las Himalàyas, *the Himalayas.*
el verànо, *the summer.*
el invièrno, *the winter.*
prometido (from prometèr), *promised.*
la oportunidàd, *the opportunity.*
hàsta ahòra, *until now, hitherto.*
la presència, *the presence.*
las condiciònes, *the conditions, terms.*
la vìsta, *the sight* (of a bill of exchange).
la cláusula, *the clause.*

Exercise 9

Translate into English :—

1. Es imposìble hacèr èsto. 2. Nuèstros dependièntes estùdian divèrsas lènguas y son mùy aplicàdos. 3. Mi cliènte me visitó anteayèr. 4. Él me visitàba càda mes durànte el àño pasàdo. 5. ¿ Habló V. con el cajèro ó con el secretàrio ? 6. Cuàndo yo iba allí, sièmpre hablàba con el jèfe de la càsa. 7. Escribíamos cuàndo V. nos dijo èso. 8. No faltó nàda y quedàmos mùy satisfèchos. 9. Si Vs. continúan á ser holgazànes, nùnca serán rìcos ni felices, sino sièmpre infelices y pòbres. 10. ¿ Qué tejidos producìa el fabricànte ? 11. Èste fabricànte producìa los géneros que después vendíamos á nuèstros clièntes. 12. Las fábricas produjèron tòdas èstas pièzas. 13. Tèngo más empleàdos ahòra que tenía en el àño pasàdo. 14. Las muèstras que Vs. tuvièron de sus clièntes son muy bonitas. 15. Tendríamos más pedidos si tuviésemos (impf. subjunctive of tener) capitàles suficièntes. 16. Estòy en el almacén tòdo el día. 17. Después de trabajàr tòdo el día estàmos mùy cansàdos. 18. ¿ Estarán listos los géneros á tièmpo pàra el vapòr ? 19. Ya están expedidos tòdos los bùltos de V. 20. Son escritas nuèstras càrtas por un dependiènte mùy capàz.

Exercise 10

Translate into Spanish :—

1. It would be impossible to do more than you are doing. 2. Are our employees, who study various languages, very diligent ? (Translate : Are very diligent our, etc.). 3. When did your clients visit you the last time ? (Translate : When visited, etc. Past Definite). 4. The clerks are lively (of a lively disposition) and their friends in the French army are still alive. 5. I am very pleased to hear that you are well. 6. We are very fond of our cashier, for he is a good fellow. 7. It is better not to eat fruit when it is green (unripe). 8. Most apples are green, this is their natural colour. 9. Are they employees of Messrs. Gonzales and Co., and were they always as busy as they seem now ? 10. They pay very well and indeed they are the best customers (clients) in the world. 11. Is it true that you will have a remittance for us to-morrow ? 12. Will the goods be already forwarded to-morrow or the day after ? (Two ways : with ser for the act of forwarding, and with estar for the completed state). 13. We are tired of being (of to be) occupied all day and all night. 14. The Himalayas are always covered with snow, both in summer and in winter. 15. When shall you be here to (para) do the work you promised ? 16. How is it (ser) that the goods are not yet ready ? 17. We used to have more time to (para) study than (insert : that which = lo que) we have now. 18. He will have less opportunities in the future than (insert : those which = las que) he has had until now. 19. Nothing but (sino) your presence is wanting to complete our happiness. 20. Nothing was missing (Past Definite —on that particular occasion) and they were all satisfied.

Key to Exercise 2

1. Being able to order the new designs. 2. We had not offended you. 3. Shall you speak about this matter to-day ? 4. The printers had printed the circulars the day before yesterday. 5. Saying this, he has handed over the patterns to me. 6. Why had he left the designs with us ? 7. They will have done that in order to please their customers. 8. I shall have said all to him. 9. You will have left the order-note in the hands of his customer. 10. They will have caught the nine o'clock train without fail. 11. If you have executed the order, you can order the packages to-day. 12. This cloth was worth more than threepence per yard. 13. You will have followed all my instructions. 14. We had paid very low prices. 15. We have returned the pieces this morning.

1. Habrèmos vuèlto las pièzas pasàdo mañàna. 2. ¿ Qué dirá V. si no hèmos pagàdo la cuènta ? 3. ¿ Dóndo había puèsto las lètras ? 4. ¿ Sàben Vs. si los clièntes han vuèlto tòdas las pièzas ? 5. Vinièndo tempràno, ha hècho tòdo èste trabàjo. 6. Habièndo vuèlto èsta mañàna, ha mandàdo las géneros. 7. Nosòtros habíamos ròto los huévos. 8 Picièndo las tèlas anteayèr, los hèmos recebìdo hoy. 9. ¿ Habíamos dicho tòdo á V. ? 10. Hèmos imprèso las circulàres. 11. Vs. habrán escrito las càrtas. 12. Habré pagàdo prècios bàjos. 13. Dicièndo èsto, ha entregàdo á Vs. las muèstras. 14. Èsta tèla valía más de cuàtro peniques la yàrda. 15. ¿ Puèden Vs. complacèr al cliènte ?

A. C.

Continued from page 36.

GEOGRAPHY:

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ASIA.—II

ASIA is unique among the continents of the globe in having large internal drainage areas; one of the most remarkable of these being the deep trough of the Dead Sea which forms the valley of the Jordan. The Jordan rises in Mount Hermon; falls into the small Lake Merom, thence flows through a rocky gorge for ten miles to the Sea of Galilee, which is nearly 700 feet below the surface of the Mediterranean. This lake, amid grassy hills, is, as it was in Biblical times, a sheet of clear water abounding in fish. From the Sea of Galilee the Jordan flows southward for about 200 miles into the Dead Sea, falling in that distance another 600 feet.

Caspian and Aral Seas

The Dead Sea itself is some 1,300 feet below sea level. The Dead Sea is some 50 miles long by eight miles wide, and as it is in its deepest part 1,300 feet, it is evident that the total depth of the chasm is over half a mile below the Mediterranean.

The lake is surrounded by bare limestone cliffs from 1,500 to 2,500 feet high; the water is clear and blue but so salt that the human body cannot sink in it.

The largest inland drainage area of Asia is that of the Caspian and Aral Seas, the area being about 4,000,000 square miles. The Caspian Sea receives the Volga and Ural Rivers, besides others not so important. The Aral Sea receives the drainage of the Pamirs, Tian Shan and Altai Mountains, through the rivers Oxus and Jaxartes.

The Caspian Sea is the largest inland sheet of water on the globe, being 760 miles long from north to south, while its greatest breadth is 280 miles. The water is salt, the shores generally low, flat and sandy, and its surface is over 80 feet below the level of the Black Sea.

At one time, geologically not so very distant, it was connected with the Aral Sea, but in consequence of evaporation the two are now separated by a distance of nearly 200 miles. This evaporation is still continuing and, in consequence, the Caspian Sea is even now slowly shrinking. On its shores are the ports of Astrakhan, Petrovsk, Baku, Krasnovodsk, etc. Large quantities of sturgeon are caught in its waters, especially near the estuary of the Volga.

The Aral Sea is much smaller than the Caspian, but is still the second largest lake in Asia. Like the Caspian, it is also drying up. The water, though not fresh, is only very slightly saline, and contains large quantities of fish of fresh-water types.

The River Oxus

A curious fact about the Oxus, or Amu-Darya, is that twice during historical time it has altered its course and flowed into the Caspian Sea instead of the Aral Sea; traces of these old river beds are still to be found in a line of wells across the plains.

The Jaxartes, or Syr-Darya, drains the Tian Shan and Altai Mountains. Its course is roughly parallel to that of the Oxus and it enters the Aral Sea at its northern extremity. Like the Oxus it also has shifted its bed, but if it ever flowed into the Caspian it could only have been through the Oxus itself.

Lake Balkash, a narrow lake some 330 miles long is also to be considered as part of the Aralo-Caspian drainage area. Into it flows the Ili—partly a Russian and partly a Chinese stream. It drains the northern end of the Tian Shan.

Lake Issyk Kul is an upland lake situated in the heart of the Tian Shan at an altitude of 5,300 feet. Like the lakes on the steppes below this is also shrinking in size. It is slightly salt and abounds with fish. At its extreme eastern extremity stands the great mountain of Khan-Tengri, the highest of the Tian Shan range.

The region of Russian Turkestan which is drained by the rivers we have just mentioned is a land of very varied character. The northern slopes of the range separating it from Persia are very fertile and this district is traversed by the Trans-Caspian railway.

To the north of this is an inhospitable region, until, when the Oxus is reached, we have the Oasis of Khiva.

Beyond the Oxus lie the districts of Bokhara and Samarkand, where the country is well cultivated and flourishing. Wherever it has been possible to employ the mountain torrents the country is extraordinarily fertile, but lower down towards the Aral Sea vegetation practically disappears in the sandy steppes.

North of the Aral Sea lies the district of the Kirghiz Steppes. These consist of "vast rolling country of moderate elevation and clothed with grass."

The climate of the great Aralo-Caspian basin is of the continental type and is remarkable for the absence of precipitated moisture. In some parts rain does not fall for years together. Were it not for the rivers which are fed by the mountain snows the greater part of the basin would be uninhabitable.

Khiva

In the oases such as that of Khiva, wheat and rice are grown besides cotton, flax and tobacco. Especially well do fruits flourish such as apples, plums, peaches, apricots, grapes, melons, etc. The higher lands situated on the slopes of the Tian Shan have good forest growths of spruce, mountain ash, etc. Of domestic animals there are the camel, horse, sheep and cattle; in the thickets round the Oxus delta are found wild boars, tigers, wolves, etc., and in the open desert the wild ass, gazelles and other animals.

The inhabitants of Turkestan are of mixed origin of Túrki, Iranic and Galcha stock, partly nomadic in habit but frequently settled down in agricultural pursuits.

The chief river basins that drain the northern half of the Asiatic continent are those of the Obi, with its tributaries the Tobol and the Irtish, the Yenisei, and the Lena. These drainage basins, with that on the left bank of the Amur, practically constitute the whole of the Russian province of Siberia, which occupies the entire northern part of the continent, with an area of over 4,500,000 square miles and a population, estimated before the Great War, of about 10,000,000.

All the Siberian rivers flow from the southern highlands northward into the Arctic Ocean, and their many tributaries, running as they do more or less at right angles to the main streams, afford a magnificent and unparalleled system of water highways in all directions. Unfortunately all these rivers are frozen for many months of the year, and the mouths of those entering the Arctic Ocean are open only for two or three months in the summer.

The Obi, at the western extremity of Siberia, drains an area of nearly 1,500,000 square miles and affords the longest stretches of navigable waters. Its head streams are the Tobol, extending back to the watersheds between the Obi basin and the Aral Sea; and the Irtish, rising in the Chinese Altai Mountains. Altogether the Obi has over 9,000 miles of navigable waters.

The Yenisei, draining the centre of Siberia, and its great tributary the Angara rise also in China behind the surrounding mountain barrier through which they have forced their way towards the sea. The Angara, its eastern branch, flows through Lake Baikal, the largest fresh-water lake in Asia.

Lake Baikal

This extraordinary lake has in parts a depth of 5,600 feet, which brings its bed to over 4,000 feet below sea level. It occupies two deep fissures in the mountain plateau. The Yenisei drains an area of over 1,000,000 square miles and has 5,000 miles of navigable waters. The length from the headwaters of the Angara to the outflow into the sea is about 3,300 miles.

The Lena, the third of the three great northern flowing rivers, rises near Lake Baikal and flows north-east as far as Yakutsk, when it turns more or less north and flows into the Arctic Ocean after a course of about 6,000 miles, and draining an area of over 1,000,000 square miles.

The Amur, the only important river of northern Asia draining eastward to the Pacific Ocean, is formed by the junction of two streams flowing, one mostly through Russian, and the other through Chinese territory. Commercially it is of more importance than the whole of the north flowing river systems put together, even although the Amur's open season only lasts from May to October.

As might be expected, this great northern drainage system extending between 130° of longitude and 30° of latitude, offers a great diversity of natural features, climate, etc.

At Verkhoyansk, just within the Arctic Circle, the temperature falls in January to below –89° Fahr. and this is considered to be the coldest region on the earth. Yet in summer a temperature of 88° Fahr. is frequently registered, thus showing the tremendous extremes of a continental climate.

Photo: J. Shepstone.

THE RIVER JORDAN

rises in Mount Hermon, falls into Lake Merom, thence passes through a rocky gorge for ten miles into the Sea of Galilee, whence it flows (a distance of 200 miles) into—

Photo: American Colony.

—THE DEAD SEA,

shown above as viewed from Engedi looking south. This remarkable lake, which is so salt that the human body cannot sink in it, is about 1,300 ft. below the level of the Mediterranean and is surrounded by bare limestone cliffs.

The intense heat, however, lasts but a few weeks, whereas the cold prevailing for many months has frozen the ground permanently from a depth of perhaps 300 to 400 feet to within about two or three feet of the surface.

Generally speaking the northern parts, mostly within the Arctic circle, comprise the Tundra, extending generally down to as far as 66° N. latitude, a region of swamps and stunted, sickly vegetation. For eight months of the year the ground is covered with snow, and storms rage, often for twenty-four hours at a stretch ; the sky is perpetually overcast and is relieved only by the magnificent Aurora Borealis or " Northern Lights." Yet in parts some river districts are covered by an almost luxurious vegetation.

To the south the forest region encroaches on the Tundra wherever the rivers occur. In this, the productive " Black Earth " region, are found the wheat belts. The forests are of larch, birch, cedar and the Siberian pine. South of the forest zone, in the Obi basin, occurs the Steppe, which owing to lack of rainfall somewhat resembles the Tundra in absence of vegetation.

Khamchatka

The peninsula of Khamchatka is more fertile, and along the streams grasses and flowers grow with a nearly tropical profusion. Peculiar to this district is a very rare specimen of lily.

The Amur basin is also, owing to the moist climate, very fertile. Among the trees are oak, elm, ash, conifers, etc., and generally the vegetation is not only characteristic of the latitude but has many features we should expect only in sub-tropical countries.

Of animals found in Siberia we may mention the bear, fox, marten, sable and other fur-bearing animals, including the grey squirrel. Deer, elk, reindeer and an enormous number of small rodents such as marmots and lemmings abound ; salmon, sturgeon, carp and many other varieties of fish are found in abundance in the lakes and rivers.

Of domestic animals the camel and fat-tailed sheep in the steppe, and the yak in the northern parts of the Yenisei basin, are the most important. In ages past the mammoth and the rhinoceros were very common, and enormous quantities of " fossil " ivory of these animals, preserved in the frozen soil of the Tundra, etc., have been obtained by excavation.

Minerals are distributed all over Siberia and include gold, silver, platinum, lead, iron, graphite, etc., and manufactures of iron are established in Transbaikalia, at Petrovsk and other places ; the chief industries are naturally agriculture, market gardening, bee-keeping, cattle grazing and horse breeding. There are, however, a large number of distilleries.

The inhabitants of Siberia are mostly Slavonic, but native tribes include the Kirghiz in the south-west, Buriats in Irkutsk, Ainus in the island of Sakhalin, Yakuts, etc.

Communications in Siberia are naturally elementary. With the exception of the Siberian railway from the Urals to Vladivostok there are no railways in Siberia proper, but railway communications are being opened up with China. Japanese influence is largely responsible for the railway development which has occurred in Mongolia and Manchuria.

The trans-Siberian railway starts at Chelyabinsk and extends for over 4,000 miles to Vladivostok on the Japan Sea, the latter part running through Manchuria. The journey from Moscow to Vladivostok takes about fifteen days.

The entire population of Siberia does not greatly exceed 10,000,000, and the towns of over 20,000 inhabitants are but three in number, Irkutsk, Tomsk, and Omsk.

The Old Siberia

In former times convicts from Russia-in-Europe were sent to Siberia to serve their sentences, and many vivid accounts have been given by both Russian and foreign authors of the hardships and cruelties that they endured. They were either assigned to private mine owners or manufacturers.

Since the Great War the internal state of Siberia, like that of its parent, European Russia, has been distracted by internal strife. It has split up into a number of independent states, though whether these will prove capable of a permanent existence is doubtful. Among these may be mentioned the Eastern Siberian Republic of Yakutsk, the Republic of Turkestan, etc. But any account of these would be apt to mislead, as the unsettled state of the country renders it liable to change almost every day.

It will be realised from the foregoing account that the old popular idea of Siberia as consisting exclusively of a great country covered with snow and at the mercy of an Arctic climate is not correct. To some of the districts of this vast territory the popular idea may have some relation, but an enormous area of the country is capable of development under energetic and intelligent direction.

C. J. S.

BUILDING THE TRANS-SIBERIAN RAILWAY.

Completed in 1905, this railway, which runs from the Urals to Vladivostok, remains the only railway in Siberia proper, a land where communications are still very elementary.

THE OUTSKIRTS OF TOMSK.

One of the three Siberian towns which alone are of any size or importance. The other two are Irkutsk and Omsk.

Continued from page 43.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.
(M. A. Lewenz, M.A.[Lond.]).

TRIGONOMETRY.– VI

54. Examples:–

(1) If $A + B + C = 180°$ show that

$$\frac{\tan \frac{1}{2} A}{\tan \frac{1}{2} C} = \frac{1 - \cos A + \cos B + \cos C}{1 - \cos C + \cos A + \cos B}$$

$$\frac{1 - \cos A + \cos B + \cos C}{1 - \cos C + \cos A + \cos B}$$

$$= \frac{2 \sin^2 \frac{A}{2} + 2 \cos \frac{B + C}{2} \cdot \cos \frac{B - C}{2}}{2 \sin^2 \frac{C}{2} + 2 \cos \frac{A + B}{2} \cdot \cos \frac{A - B}{2}}$$

Now $\cos \frac{B + C}{2} = \cos \frac{A + B + C - A}{2}$

$$= \cos \frac{180° - A}{2} = \cos \left(90° - \frac{A}{2}\right) = \sin \frac{A}{2}$$

Similarly $\cos \frac{A + B}{2} = \sin \frac{C}{2}$

$$\therefore \frac{2 \sin^2 \frac{A}{2} + 2 \cos \frac{B + C}{2} \cdot \cos \frac{B - C}{2}}{2 \sin^2 \frac{C}{2} + 2 \cos \frac{A + B}{2} \cdot \cos \frac{A - B}{2}}$$

$$= \frac{2 \sin \frac{A}{2} \left(\sin \frac{A}{2} + \cos \frac{B - C}{2}\right)}{2 \sin \frac{C}{2} \left(\sin \frac{C}{2} + \cos \frac{A - B}{2}\right)}$$

$$= \frac{\sin \frac{A}{2} \left(\cos \frac{B + C}{2} + \cos \frac{B - C}{2}\right)}{\sin \frac{C}{2} \left(\cos \frac{A + B}{2} + \cos \frac{A - B}{2}\right)}$$

$$= \frac{2 \sin \frac{A}{2} \cdot \cos \frac{B}{2} \cdot \cos \frac{C}{2}}{2 \sin \frac{C}{2} \cdot \cos \frac{A}{2} \cdot \cos \frac{B}{2}}$$

$$= \frac{\frac{\sin \frac{A}{2}}{\cos \frac{A}{2}}}{\frac{\sin \frac{C}{2}}{\cos \frac{C}{2}}} = \frac{\tan \frac{1}{2} A}{\tan \frac{1}{2} C}$$

(2) Show that $\tan^{-1} \frac{1}{2} + \tan^{-1} \frac{1}{3} = \frac{\pi}{2}$

Let $\alpha = \tan^{-1} \frac{1}{2}$ and let $\beta = \tan^{-1} \frac{1}{3}$

then $\tan \alpha = \frac{1}{2}$ and $\tan \beta = \frac{1}{3}$

$$\therefore \tan (\alpha + \beta) = \frac{\tan \alpha + \tan \beta}{1 - \tan \alpha \tan \beta} = \frac{\frac{1}{2} + \frac{1}{3}}{1 - \frac{1}{6}} = 1$$

$\therefore \alpha + \beta$ is one of the angles included in the form $n\pi + \frac{\pi}{4}$

Now $\alpha < \frac{\pi}{4}$ and $\beta < \frac{\pi}{4}$ $\therefore \alpha + \beta < \frac{\pi}{2}$

Also $\alpha + \beta$ is a positive angle.

$\therefore$ n must be positive and < 1 $\therefore$ n must $= 0$

$\therefore \alpha + \beta = \frac{\pi}{4}$, i.e. $\tan^{-1} \frac{1}{2} + \tan^{-1} \frac{1}{3} = \frac{\pi}{4}$

(3) Show that

(*a*) $4 \tan^{-1} \frac{1}{5} - \tan^{-1} \frac{1}{239} = \frac{\pi}{4}$

and (*b*) that $\tan^{-1} \frac{1}{239} = \tan^{-1} \frac{1}{70} - \tan^{-1} \frac{1}{99}$

(*a*) let $\alpha = \tan^{-1} \frac{1}{5}$ and $\beta = \tan^{-1} \frac{1}{239}$

then $\tan 2\alpha = \frac{2 \tan \alpha}{1 - \tan^2 \alpha} = \frac{\frac{2}{5}}{1 - \frac{1}{25}} = \frac{10}{24} = \frac{5}{12}$

$$\therefore \tan 4\alpha = \frac{2 \tan 2\alpha}{1 - \tan^2 2\alpha} = \frac{\frac{5}{6}}{1 - \frac{25}{144}} = \frac{120}{119}$$

$$\therefore \tan (4\alpha - \beta) = \frac{\tan 4\alpha - \tan \beta}{1 + \tan 4\alpha \cdot \tan \beta} = \frac{\frac{120}{119} - \frac{1}{239}}{1 + \frac{120 \times 1}{119 \times 329}}$$

$$= \frac{28680 - 119}{28441 + 120} = \frac{28561}{28561} = 1$$

$\therefore 4 \tan^{-1} \frac{1}{5} - \tan^{-1} \frac{1}{239} = \frac{\pi}{4}$

(*b*) let $\alpha = \tan^{-1}\frac{1}{70}$ and $\beta = \tan^{-1}\frac{1}{99}$

$$\tan(\alpha - \beta) = \frac{\frac{1}{70} - \frac{1}{99}}{1 + \frac{1}{70}\cdot\frac{1}{99}} = \frac{29}{6931} = \frac{1}{239}$$

$$\therefore \tan^{-1}\frac{1}{239} = \tan^{-1}\frac{1}{70} - \tan^{-1}\frac{1}{99}$$

(4) Eliminate θ from the equations

$x = 2a \sin\theta \sin 2\theta - a\cos\theta$ . . . . (i)

$y = 2b \sin\theta \cos 2\theta + b \sin\theta$ . . . (ii)

from (1) $x = a(\cos\theta - \cos 3\theta - \cos\theta)$

$= -a \cos 3\theta$

$$\therefore \frac{x}{a} = -\cos 3\theta \quad . \quad . \quad . \quad . \quad . \quad . \quad . \text{ (iii)}$$

from (ii) $y = b(\sin 3\theta - \sin\theta + \sin\theta) = b \sin 3\theta$

$$\therefore \frac{y}{b} = \sin 3\theta \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \text{ (iv)}$$

squaring (iii) and (iv) and adding, we have

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = \cos^2 3\theta + \sin^2 3\theta = 1$$

$$\text{i.e. } \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

Exercise 12

If $A + B + C = \pi$, prove that

(1) $\cot B \cot C + \cot C \cot A + \cot A \cot B = (1)$

(2) $(\sin A + \sin B + \sin C)(\sin B + \sin C - \sin A) \times (\sin C + \sin A - \sin B)(\sin A + \sin B - \sin C) = 4 \sin^2 A \sin^2 B \sin^2 C$

(3) $\sin^2\frac{A}{2} + \sin^2\frac{B}{2} + \sin^2\frac{C}{2} + 2\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2} = 1$

(4) $\cos A + \cos B + \cos C$

$$= \sin\frac{A}{2}\cdot\cos\frac{B-C}{2} + \sin\frac{B}{2}\cdot\cos\frac{C-A}{2} + \sin\frac{C}{2}\cdot\cos\frac{A-B}{2}$$

Prove geometrically

(5) $\dfrac{\tan\alpha + \tan\beta}{\tan\alpha - \tan\beta} = \dfrac{\sin(\alpha+\beta)}{\sin(\alpha-\beta)}$

(6) $\cos 2a = \dfrac{1 - \tan^2\alpha}{1 + \tan^2\alpha}$

Trace the changes in sign and magnitude, as θ increases from 0 to 2π, of

(7) $\sqrt{3}\cos\theta$. (8) $\dfrac{\cos 2\theta}{\cos\theta}$. (9) $\tan\theta - 2\operatorname{cosec} 2\theta$.

(10) Eliminate θ from the equations

$x = 2a \sin 3\theta \cos\theta - a \sin 2\theta$

$y = 2b \cos 3\theta \cos\theta - b \cos 2\theta$

Solve the equations

(11) $4 \sin\theta \cdot \sin 3\theta = (1)$. (12) $\sin 5\theta = 16 \sin 5\theta = 2$. (13) $\sin 3\theta - 2\sin^3\theta = \frac{3}{4}$.

Show that

(14) $\dfrac{\sin\alpha + \sin\beta + \sin(\alpha+\beta)}{\sin\alpha + \sin\beta - \sin(\alpha+\beta)} = \cot\frac{\alpha}{2}\cdot\cot\frac{\beta}{2}$

(15) $\dfrac{\sin A \sin 2A + \sin A \cdot \sin 4A + \sin 2A \sin 7A}{\sin A \cos 2A + \sin 2A \cos 5A + \sin A \cos 8A} = \tan 5A$

(16) if $\tan A = \dfrac{b}{a}$ then $\sqrt{\dfrac{a+b}{a-b}} + \sqrt{\dfrac{a-b}{a+b}} = \dfrac{2\cos A}{\sqrt{\cos 2A}}$.

(17) Prove geometrically that given the value of $\cos A$, there are three different values for $\cos\frac{A}{3}$ and six different values for $\sin\frac{A}{3}$.

(18) Prove that $\tan^{-1}\dfrac{a - \sqrt{a^2-4}}{2\sqrt{a+1}} + \tan^{-1}\dfrac{1}{\sqrt{a+1}} + \tan^{-1}\dfrac{a + \sqrt{a^2-4}}{2\sqrt{a+1}} = n\pi + \frac{\pi}{2}$

(19) If $\sin\alpha$ and $\sin\beta$ be two values of $\sin\theta$ satisfying the equation $a\cos 2\theta + b \sin 2\theta = c$

then $\cos 2\alpha - \sin^2\beta = \dfrac{ac}{a^2 + b^2}$

55. Mathematical Tables.—In trigonometrical calculations the following tables are required.

(1) A table of the logarithms of natural numbers from 1 to 100,000.

(2) A table of the trigonometrical ratios of angles for every minute from 0° — 90°.

(3) A table of the logarithms of these ratios.

The student is recommended to get Chambers' *Mathematical Tables*.

For the fundamental properties of logarithms and their use, the student is referred to the courses on Algebra and on Logarithms.

Here we can only add the following remarks.

56. The Principle of Proportional Parts which states that the difference between the logarithms of two numbers is proportional to the difference between the numbers themselves, applies also to the trigonometrical ratios and to the logarithms of these ratios.

Further, since the cosines and sines of all acute angles, the tangents of all acute angles less than 45° and the cotangents of all acute angles greater than 45° are less than unity, the logarithms of these will have a negative characteristic.

It is usual in order to avoid printing this negative characteristic in the tables, to add 10 to the logarithm.

The logarithm thus printed is called the **logarithmic sine, cosine, tangent,** etc., of the angle, and is written thus, L sin α, L cos β, L tan γ and so on.

Thus L sin α = log sin α + 10.

e.g. L sin 13° 20′ = 9·3628892

$\therefore$ log sin 13° 20′ = $\bar{1}$·3628892

The student must remember that the mantissa of a logarithm is always positive.

Examples:—

(1) Find cos 42° 50′ 20″

In the tables of natural cosines we find cos 42° 50′ = ·7333345 and cos 42° 51′ = ·7331367.

Let cos 42° 50′ 20″ = ·7333345 − d (the cosine diminishes as the angle increases).

then $d = \frac{20}{60}$ of ·0001978 = ·0000659

$\therefore$ cos 42° 50′ 20″ = **·7332686.**

Here we have again made use of the rule of proportional parts.

(2) Find the angle whose logarithmic sine is 9·6596178

From the tables L sin 27° 10′ = 9·6595173
L sin 27° 11′ = 9·6597633
Let 9·6596178 = L (sin 27° 10′ + d)
9·6596178 − 9·6595173 = ·0001005
9·6597633 − 9·6595173 = ·0002460
27° 11′ − 27° 10′ = 1′ = 60″

$$\therefore \frac{d}{60} = \frac{\cdot 0001005}{\cdot 0002460} = 25 \text{ approximately}$$

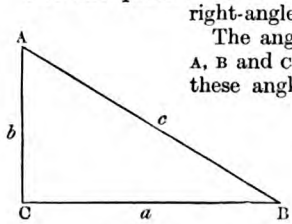
$\therefore$ L sin 27° 10′ 25″ = **9·6596178.**

57. The solution of right angled triangles.

In every triangle there are six elements: 3 sides and 3 angles. If we know three of these elements, *provided one of them be a side*, we can find the others.

The process of finding these is called **the solution of the triangle.**

For the present we shall confine ourselves to right-angled triangles.



The angles will be denoted by A, B and C, and the sides opposite these angles by a, b and c.

Case I.—Given the hypotenuse c and one acute angle A, *to find the two sides a and b, and the other angle* B.

The angle C is a right angle $\therefore$ A + B = 90°
$\therefore$ B = 90° − A.

$$\frac{a}{c} = \sin A \therefore a = c \sin A \therefore \log a = \log c + \log \sin A$$

$$\frac{b}{c} = \sin B \therefore b = c \sin B \therefore \log b = \log c + \log \sin B.$$

Case II.—Given one side a and one acute angle B, *to find the hypotenuse c, the other side b and the other angle* A.

A = 90° − B

$$\frac{c}{a} = \sec B \therefore c = a \sec B \therefore \log c = \log a + \log \sec B$$

$$\frac{b}{a} = \tan B \therefore b = a \tan B \therefore \log b = \log a + \log \tan B.$$

Case III.—Given the hypotenuse and one side a, to find the other side b and the acute angles A *and* B.

$$c^2 = a^2 + b^2 \therefore b^2 = c^2 - a^2 = (c - a)(c + a)$$

$$\therefore \log b = \frac{1}{2}\{\log (c - a) + \log (c + a)\}$$

$$\text{Sin A} = \frac{a}{c} \therefore \log \sin A = \log a - \log c$$

$$\text{Sin B} = \frac{b}{c} \therefore \log \sin B = \log b - \log c$$

or B can be found from the equation B = 90° − A

Case IV.—Given the two sides a and b containing the right angle, to find the hypotenuse c and the acute angles A *and* B.

$$\tan A = \frac{a}{b} \therefore \log \tan A = \log a - \log b$$

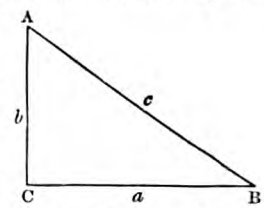
$$\tan B = \frac{b}{a} \therefore \log \tan B = \log b - \log a$$

or B can be found from the equation B = 90° − A

$$\frac{c}{a} = \text{cosec A} \therefore c = a \text{ cosec A} \therefore \log c = \log a + \log \text{cosec A}.$$

58. Practical Applications.

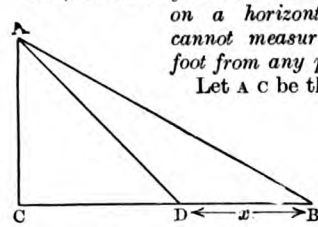
To find the height of a tower on a horizontal plane, given the distance of the foot of the tower from a point in the plane.



We can measure the distance a, of the point B from the foot C of the tower, and we can measure the angle of elevation of the top of the tower at the point B, i.e. we can measure $\angle$ B.

Then $\frac{b}{a} = \tan B \therefore \log b = \log a + \log \tan B.$

To find the height and distance of a tower standing on a horizontal plane, when we cannot measure the distance of its foot from any point in the plane.



Let A C be the tower, and in the horizontal plane take a straight line B D of any length x, which if produced would pass through the foot C of the tower. Measure the angles of elevation of A at B and D, i.e. the $\angle$ A B C and $\angle$ A D C.

Now, B C = C A cot A B C and D C = C A cot A D C

Now, B D = x = B C − D C = C A (cot A B C − cot A D C)

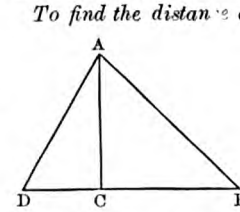
$$= \text{C A} \frac{\cos \text{A B C} \sin \text{A D C} - \sin \text{A B C} \cdot \cos \text{A D C}}{\sin \text{A B C} \cdot \sin \text{A D C}}$$

$$= \text{C A} \frac{\sin (\text{A D C} - \text{A B C})}{\sin \text{A D C} \sin \text{A B C}}$$

$$\therefore \text{C A} = x \frac{\sin \text{A D C} \sin \text{A B C}}{\sin (\text{A D C} - \text{A B C})}$$

Whence it is easy to find C D since C D = C A cot A D C.

To find the distance of an inaccessible object on a horizontal plane.



Let A be the object and take a base line B D in the plane. Measure angles A D B and A B D. Draw A C $\perp$ to B D

B C = A C cot A B D and C D = A C cot A D B

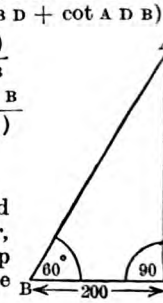
$$\text{B D} = \text{B C} + \text{C D} = \text{A C} (\cot \text{A B D} + \cot \text{A D B})$$

$$= \text{A C} \frac{\sin (\text{A B D} + \text{A D B})}{\sin \text{A B D} \cdot \sin \text{A D B}}$$

$$\therefore \text{A C} = \frac{\text{B D} \sin \text{A B D} \sin \text{A D B}}{\sin (\text{A B D} + \text{A D B})}$$

Examples:—

59.



(1) At a point 200 feet from, and on a level with, the base of a tower, the angle of elevation of the top of the tower is 60°. What is the height of the tower?

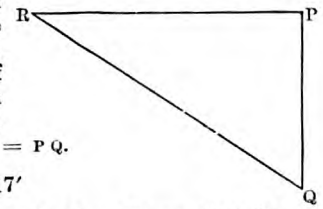
If A C be the tower, then B C = 200 feet.

B = 60°, C = 90°

$$\frac{\text{A C}}{\text{B C}} = \tan 60° \therefore \text{A C} = \text{B C} \tan 60° = 200\sqrt{3}$$

$\therefore$ height of tower = **200 $\sqrt{3}$ feet.**

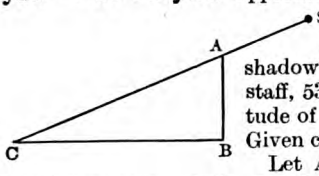
(2) From a point P on the bank of a river, just opposite a point Q on the other bank, a man walks at right angles to PQ to a point R, so that PR = 100 yards. He then observes the angle PRQ to be 32° 17′: find the breadth of the river. Given tan 32° 17′ = ·6317667.



Breadth of river = PQ.

$\frac{PQ}{PR} = \tan 32° 17'$

$\therefore PQ = PR \cdot \tan 32° 17' = 100 \times ·6317667$ yds. = **63·18 yds.** approximately.



(3) Find the length of the shadow of a vertical flagstaff, 53 feet high, the altitude of the sun being 22°. Given cot 22° = 2·4750869.

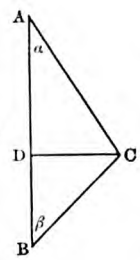
Let AB be the flagstaff, and let *s* represent the position of the sun. Then the shadow AB will be BC, and C = 22°

$\frac{CB}{AB} = \cot 22° \therefore CB = 53 \times 2·4750869$ feet

= **131 ft. 2 in.** approximately.

(4) At two points 2400 yards apart on a road running north and south, the bearings of a spire are observed to be E. 57° S. and E. 43° N. Find the distance of the spire from the road.

Given L sin 33° = 9·7361088
L sin 47° = 9·8641275
L sin 80° = 9·9933515
log 2400 = 3·3802112
log 970·724 = 2·9870760



Let A and B be the two points on the road and C the spire.

Draw CD ⊥ to AB

$\alpha = 90° - 57° = 33°$,

$\beta = 90° - 43° = 47°$

AB = 2400 yards.

$AD = CD \cot \alpha \quad BD = CD \cot \beta$

$AB = AD + BD = (\cot \alpha + \cot \beta)\, CD$

$\therefore CD = \frac{AB}{\cot \alpha + \cot \beta} = AB \frac{\sin \alpha \sin \beta}{\sin (\alpha + \beta)}$

$\therefore \log CD = \log \frac{AB \sin \alpha \sin \beta}{\sin (\alpha + \beta)}$

$= \log AB + \log \sin \alpha + \log \sin \beta - \log \sin (\alpha + \beta)$

$\log AB = \log 2400 = 3·3802112$

$\log \sin \alpha = \log \sin 33° = \bar{1}·7361088$

$\log \sin \beta = \log \sin 47° = \bar{1}·8641275$

$2·9804475$

$\log \sin (\alpha + \beta) = \log \sin 80° = \bar{1}·9933515$

$2·9870960$

$= \log 970·724$

$\therefore CD =$ **970·7 yards.**

Exercise 13

(1) A man 6 feet high stands at a distance of 4½ feet from a lamp-post, and his shadow measures 19 feet. Find the height of the lamp-post.

(2) Find the height of a steeple, if it is found that walking 100 feet along a straight line through its base changes the angle of elevation from 46° 10′ to 24° 40′

Given L sin 46° 10′ = 9·8581505
L sin 24° 40′ = 9·6204884
L sin 21° 30′ = 9·5640754
log 821434 = 5·9145735

(3) From a milestone on a straight road, a chimney is observed to lie in a direction making an angle of 30° with the road. At the next milestone its direction makes an angle of 60° with the road. Find the distance of the chimney from the road.

(4) The angle of elevation of a lighthouse viewed from a ship due north of it is α, and when the ship is at a point due east of its first position and at a distance c from it, the angle of elevation is β. Show that the height of the lighthouse is

$$\frac{c \sin \alpha \sin \beta}{\{\sin (\alpha + \beta) \sin (\alpha - \beta)\}^{\frac{1}{2}}}$$

Key to Exercise 9

(1) $2n\pi \pm \alpha$. (2) $n\pi + (-1)^n \alpha$. (3) $n\pi + \alpha$.

Key to Exercise 10

(1) $2n\pi \pm \frac{\pi}{3}$. (2) $n\pi + (-1)^n \frac{\pi}{6}$. (3) $n\pi + \frac{\pi}{4}$.

(4) $n\pi - \frac{\pi}{4}$. (5) $n\pi + (-1)^n \frac{\pi}{10}, n\pi - (-1)^n \frac{3\pi}{10}$.

(6) $\frac{(2n+1)\pi}{3}, \frac{2(3n+1)\pi}{9}$

(7) $n\pi + \frac{\pi}{3}, n\pi - \frac{\pi}{6}$.

Key to Exercise 11

(1) +, +. (2) −, −. (3) −, +. (4) +, −. (5) ∓.

M. A. L.

LOGARITHMS.—I

1. A TABLE of Logarithms is a collection of auxiliary numbers.

These auxiliary numbers are so constructed that the **Multiplication** of common numbers can be performed by the **Addition** of Logarithms; the **Division** of common numbers can be performed by their **Subtraction; Involution,** or raising of powers, can be performed by their **Multiplication;** and **Evolution,** or the extracting of roots, can be performed by their **Division.**

Since Addition and Subtraction are easier and shorter processes than Multiplication and Division, and again Multiplication and Division are easier and shorter processes than Involution and Evolution, it is clear that by the use of Logarithms much time and much labour, which would otherwise be expended, may be saved.

2. If any number a be taken once as a factor, or, in other words, be multiplied by unity, the result a is called the first power of a.

If any number a be taken twice as a factor, the result $a \times a$ is written a^2, and is called the second power or square of a.

Similarly $a \times a \times a = a^3$ is the third power or cube of a.

And $a \times a \times a \times \ldots$ to n factors $= a^n$ is the nth power of a.

We may take as a concrete example the powers of 2.

$2^1 = 2$ $\quad 2^6 = 2^5 \times 2 = 64$
$2^2 = 2 \times 2 = 4$ $\quad 2^7 = 2^6 \times 2 = 128$
$2^3 = 2^2 \times 2 = 8$ $\quad 2^8 = 2^7 \times 2 = 256$
$2^4 = 2^3 \times 2 = 16$ $\quad 2^9 = 2^8 \times 2 = 512$
$2^5 = 2^4 \times 2 = 32$ $\quad 2^{10} = 2^9 \times 2 = 1{,}024$

and so on.

It is proved in Algebra that—

(1) $a^m \times a^n = a^{m+n}$, i.e. the $(m + n)$th power of a.

(2) $a^m \div a^n = a^{m-n}$, i.e. the $(m - n)$th power of a.

(3) $(a^m)^n = a^{mn}$, i.e. the mnth power of a

(4) $a^{\frac{1}{m}} = \sqrt[m]{a}$, i.e. the mth root of a.

(5) $a^{\frac{n}{m}} = \sqrt[m]{a^n}$, i.e. the mth root of a^n.

(6) $a^0 = 1$.

(7) $a^{-m} = \dfrac{1}{a^m}$, i.e. the reciprocal of the mth power of a.

(8) $a^{-\frac{m}{n}} = \dfrac{1}{a^{\frac{m}{n}}}$, i.e. the reciprocal of the nth root of a^m.

We shall not prove the above in general here, but shall illustrate their truth by taking concrete examples.

(1) $2^3 \times 2^4 = (2 \times 2 \times 2) \times (2 \times 2 \times 2 \times 2)$
$= 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$
$= 2^7 = 2^{3+4} =$ **128.**

(2) $3^4 \div 3^2 = \dfrac{3 \times 3 \times 3 \times 3}{3 \times 3} = 3 \times 3 = 3^2$
$= 3^{4-2} =$ **9.**

(3) $(4^2)^3 = 4^2 \times 4^2 \times 4^2 = 4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4^6 = 4^{2 \times 3} =$ **4,096.**

(4) Consider $8^{\frac{1}{3}}$

$(8^{\frac{1}{3}})^3 = 8^{\frac{1}{3} \times 3} = 8^1 = 8$.

$\therefore 8^{\frac{1}{3}}$ is such that its cube $= 8$, i.e. $8^{\frac{1}{3}}$ is the cube root of 8, i.e. $\sqrt[3]{8} =$ **2.**

(5) Consider $2^{\frac{3}{2}}$

$(2^{\frac{3}{2}})^2 = 2^{\frac{3}{2} \times 2} = 2^3$ $\therefore 2^{\frac{3}{2}}$ is such that its square $= 2^3$, i.e. $2^{\frac{3}{2}}$ is the square root of 2^3, i.e. $\sqrt{2^3} =$ **$\sqrt{8}$.**

(6) Consider 3^0

$3^5 \div 3^5 = 3^{5-5} = 3^0$; but $3^5 \div 3^5 = \dfrac{3^5}{3^5} = 1$

$\therefore 3^0 =$ **1.**

(7) Consider 2^{-3}

$2^{-3} \times 2^3 = 2^{-3+3} = 2^0 = 1$.

$\therefore 2^{-3} =$ **$\dfrac{1}{2^3}$.**

(8) Consider $2^{-\frac{3}{4}}$

$2^{-\frac{3}{4}} \times 2^{\frac{3}{4}} = 2^{-\frac{3}{4}+\frac{3}{4}} = 2^0 = 1$

$\therefore 2^{-\frac{3}{4}} =$ **$\dfrac{1}{2^{\frac{3}{4}}}$.**

3. The small number placed above, and a little to the right of, another number to show to what power the second number is raised, is called an **index.**

Having illustrated the above laws of indices, we will now give a further definition of logarithms.

Given a fixed number called the **base,** the logarithm of any number with respect to that base is the index of the power to which the base must be raised in order to produce the number.

Thus, if $a^x = y$, x is called the logarithm of y to the base a, and this is written $x = \log_a y$.

Let us illustrate this with 2 as a base.

$2^0 = 1 \quad \therefore \quad 0 = \log_2 1$
$2^1 = 2 \quad \therefore \quad 1 = \log_2 2$
$2^2 = 4 \quad \therefore \quad 2 = \log_2 4$
$2^3 = 8 \quad \therefore \quad 3 = \log_2 8$

In this way we can make a table of natural numbers and their logarithms to the base 2.

Natural number	*Logarithm*
1	0
2	1
4	2
8	3
16	4
32	5
64	6
128	7
256	8
512	9
1,024	10

and so on.

4. The following fundamental properties of logarithms can be established by means of the laws of indices stated above.

I.—Since $a^0 = 1$ for all values of a, it follows that $\log_a 1 = 0$.

Thus, **the logarithm of 1 is 0, whatever the base may be.**

II.—If $\log_a x = m$, $\log_a y = n$, $\log_a z = p \ldots$ then $x = a^m$, $y = a^n$, $z = a^p \ldots$

$\therefore xyz \ldots = a^m \times a^n \times a^p \times \ldots$
$= a^{m+n+p+\ldots}$

$\therefore \log_a(xyz \ldots) = m + n + p + \ldots$
$= \log_a x + \log_a y + \log_a z + \ldots$

Thus, **the logarithm of a product is the sum of the logarithms of its factors.**

III.—If $\log_a x = m$ and $\log_a y = n$, then $x = a^m$ and $y = a^n$

$\therefore x \div y = a^m \div a^n = a^{m-n}$

$\therefore \log_a(x \div y) = m - n = \log_a x - \log_a y$.

Thus, **the logarithm of a quotient is the algebraic difference of the logarithms of the dividend and the divisor.**

IV.—If $x = a^m$, then $x^n = a^{nm}$ for all values of n

$\therefore \log_a x^m = nm = n \log_a x$.

Thus, **the logarithm of any power of a number is the product of the index of the power and the logarithm of the number.**

V.—If $\log_a x = m$ and $\log_b x = n$
then $x = a^m = b^n$

$$\therefore a = b^{\frac{n}{m}} \text{ and } b = a^{\frac{m}{n}}$$

$$\therefore \frac{n}{m} = \log_b a \text{ and } \frac{m}{n} = \log_a b$$

$$\therefore \log_b a \times \log_a b = \frac{n}{m} \times \frac{m}{n} = 1.$$

Also $n = m \log_b a$ $\therefore \log_b x = \log_a x \times \log_b a$.

Thus, **the logarithm of any number to the base *b* will be found by multiplying the logarithm of that number to the base *a* by the constant multiplier $\log_b a$.**

5. It has been shown in the course on Algebra how logarithms are calculated to a base e, where $e = 2{\cdot}71828\ldots$. Such logarithms are called **Napierian** logarithms, because they were first calculated by Sir John Napier.

But for the common system of logarithms the base 10 was chosen, since 10 is the radix or base of the common scale of notation.

Logarithms to the base 10 can be calculated from logarithms to the base e by means of V. above.

For $\log_e x = \log_{10} x \times \log_e 10$

$$\therefore \log_{10} x = \log_e x \times \frac{1}{\log_e 10}.$$

Knowing $\log_e 10$, we calculate $\log_{10} x$ by multiplying $\log_e x$ by the constant multiplier $\frac{1}{\log_e 10}$.

We can only indicate briefly here how logarithms are thus calculated, and the student must accept on faith statements which he will find proved in the course on Algebra.

e is the sum of the infinite series.

$$1 + \frac{1}{1} + \frac{1}{1.2} + \frac{1}{1.2.3} + \frac{1}{1.2.3.4} + \ldots$$

i.e. $e = 2{\cdot}71828\ldots$ the number to which the sum of the above series approximates when you take a very large number of terms.

Now it is found that—

$$\log_e \frac{n+1}{n}$$

$$= 2\left\{\frac{1}{2n+1} + \frac{1}{3}\frac{1}{(2n+1)^3} + \frac{1}{5}\frac{1}{(2n+1)^5} + \ldots + \frac{1}{2r+1}\frac{1}{(2n+1)} + \ldots 2r+1\right\}$$

$= \log_e(n+1) - \log_e n$ (by III. above).

This formula enables us to calculate logarithms to the base e.

For $\log_e 1 = 0$, therefore if in above formula we put $n = 1$ we have

$$\log_e 2 = \log_e 2 = 2\left\{\frac{1}{3} + \frac{1}{3}\cdot\frac{1}{3^3} + \frac{1}{5}\cdot\frac{1}{5^5} + \ldots\right\}$$

from which we calculate that $\log_e 2 = {\cdot}693147$.

Again, $\log_e \frac{3}{2} = \log_e 3 - \log_e 2$, putting $n = 2$ in the formula $= 2\left\{\frac{1}{5} + \frac{1}{3}\cdot\frac{1}{5^3} + \frac{1}{5}\cdot\frac{1}{5^5} + \ldots\right\}$

whence $\log_e 3 - \log_e 2 = {\cdot}405465$

$\therefore \log_e 3 = {\cdot}693147 + {\cdot}405465 = 1{\cdot}09861$.

Since $4 = 2^2$, $\log_e 4 = \log_e 2^2 = 2\log_e 2$ (by IV. above) $= 1{\cdot}38629$.

Similarly $\log_e 8 = 3\log_e 2 = 2{\cdot}07944$
and $\log_e 9 = 2\log_e 3 = 2{\cdot}19722$.

Again, $\log_e 6 = \log_e(2\times 3) = \log_e 2 + \log_e 3$ (by II. above)

$\therefore \log_e 6 = {\cdot}693147 + 1{\cdot}09861 = 1{\cdot}79176$.

Knowing $\log_e 6$, we can find $\log_e 7$ by putting $n = 6$ in the formula.

We get $\log_e \frac{7}{6} = \log_e 7 - \log_e 6$

$$= 2\left\{\frac{1}{13} + \frac{1}{3}\cdot\frac{1}{13^3} + \frac{1}{5}\cdot\frac{1}{13^5} + \ldots\right\}$$

$= {\cdot}15415$

$\therefore \log_e 7 = 1{\cdot}79176 + {\cdot}15415 = 1{\cdot}9459$.

Again, knowing $\log_e 9$; by putting $n = 9$ in the formula we have $\log_e \frac{10}{9} = \log_e 10 - \log_e 9$

$$= 2\left\{\frac{1}{19} + \frac{1}{3}\cdot\frac{1}{19^3} + \frac{1}{5}\cdot\frac{1}{19^5} + \ldots\right\}$$

$= {\cdot}10537$ $\therefore \log_e 10 = 2{\cdot}19722 + {\cdot}10537 = 2{\cdot}3026$.

Lastly, $\log_e 5 = \log_e \frac{10}{2} = \log_e 10 - \log_e 2$

$= 2{\cdot}3026 - {\cdot}6931 = 1{\cdot}6095$.

6. Thus we can make the following table taking the logarithms to 4 figures.

Number	*Logarithms to base e*
1	0
2	·6931
3	1·0986
4	1·3863
5	1·6095
6	1·7918
7	1·9459
8	2·0794
9	2·1972
10	2·3026

From these we can form a table of common logarithms by multiplying the logarithms to the base e by the constant multiplier (called the **modulus**) $\frac{1}{\log_e 10} = \frac{1}{2{\cdot}3026} = {\cdot}4343$.

Hence we form the following table:—

Number	*Logarithms to the base* 10
1	0
2	·3010
3	·4771
4	·6020
5	·6989
6	·7782
7	·8451
8	·9030
9	·9542
10	1·0000

The student must understand that in the actual calculation of tables of logarithms extreme accuracy is required and far more decimal places are retained than in the above rough-and-ready computation.

This will, however, suffice to show the manner in which they may be calculated. M. A. L.

Continued from page 48.

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

WATER-COLOUR DRAWING.—IV

GREY is, all things considered, the most difficult of all tints to appreciate at its proper value. To an enormous extent it varies in appearance to the eye according to the colour which is ranged alongside it. The following exercise is suggested by an eminent authority to test the student's power of perception in this regard:—

"Take three saucers, and in one mix a rather strong tint of Prussian blue, in another cadmium yellow and crimson lake, in the third prepare a grey tint, composed of cobalt and a little light red, then take two pieces of paper, and cover the upper part of one with the Prussian blue, and the upper part of the other with the cadmium yellow and crimson lake. When dry continue from the edge of each colour a wash of the grey; it will be seen that the latter in juxtaposition with the cool colour will appear to be warm, and the same in alliance with the warm colour will appear to be cold, and the two colours respectively will seem to be made more blue or yellow, that is, more intense, than if painted alone. If Indian ink be used instead of grey, the contrast is even more striking."

The Use of Grey

The main lesson to be learned from this experiment is that grey can be used to intensify the colours that come next to it.

Now turn to the sketch on p. 111, which is the subject chosen for your first exercise in colour. The treatment here is comparatively simple. You will need about nine colours, namely, yellow ochre, burnt sienna, crimson lake, sepia, brown pink, gamboge, cadmium yellow, indigo, and cobalt. With these colours you should be able to acquire a good sound knowledge of the contrast of warm and cold effects.

As suggested before, written lessons cannot carry you beyond a certain limited point. The best and indeed only method of teaching is for the pupil to work in the presence of the master who will observe the progress of work, point out what is wrong and what is right as the study proceeds, give help and advice in the handling of any particular problem, and appraise the result. Still, by reading, you can learn the general principles to be followed, and you can also be guided towards the making of those experiments by which alone you can truly learn your method of work.

Once more, you must remember to make your pencil outline complete and faint. You want to be able to see it, but no more than that. Now mark the sides of the drawing with letters as in the illustration. A A at the bottom and B B in the middle. These should be upside down. Two thirds of the way up come E E, and D D at the top.

Applying Colour

This done, turn the picture round and begin painting at the bottom, treating as though it were the top and with the usual incline. Make a mixture of cadmium yellow of rather less than medium intensity. This is a strong yellow and suits the purpose of this drawing perfectly. Wash this mixture over the space between A A and B B. After that add a little more yellow and with a stronger tint graduate the colour over the sky.

Remember that it is better to make your tint too weak rather than too strong. You can always give it another wash and so strengthen the colour, but once you have put on a strong tint you cannot reduce its intensity. Now you must wait until the painted surface is dry. Then turn the picture back again to its right position, that is to say, with the top uppermost.

From D D (which is the real top) put on a wash of cobalt blue mixed with a little crimson lake. Make this solution weaker as it goes down and bring it to an end at E E.

The blue tint, remember, should be quite light, because while the yellow became more and more impoverished and thin as it went towards the top of the drawing, the blue must not come quite to meet it; for in that case the blue would spoil the yellow and if it overlapped would tend to produce a green tint, which is not required. The hills should be washed over with the same blue as the upper part of the sky, only when these are dry, the wash should be made over again. You should be very careful, however, not to touch those parts of the hill tops which catch the light.

At the bottom of the mountains the edge should be washed off with a clean brush. Take care that no more than the edge is touched.

Now paint the water with the same yellow that is

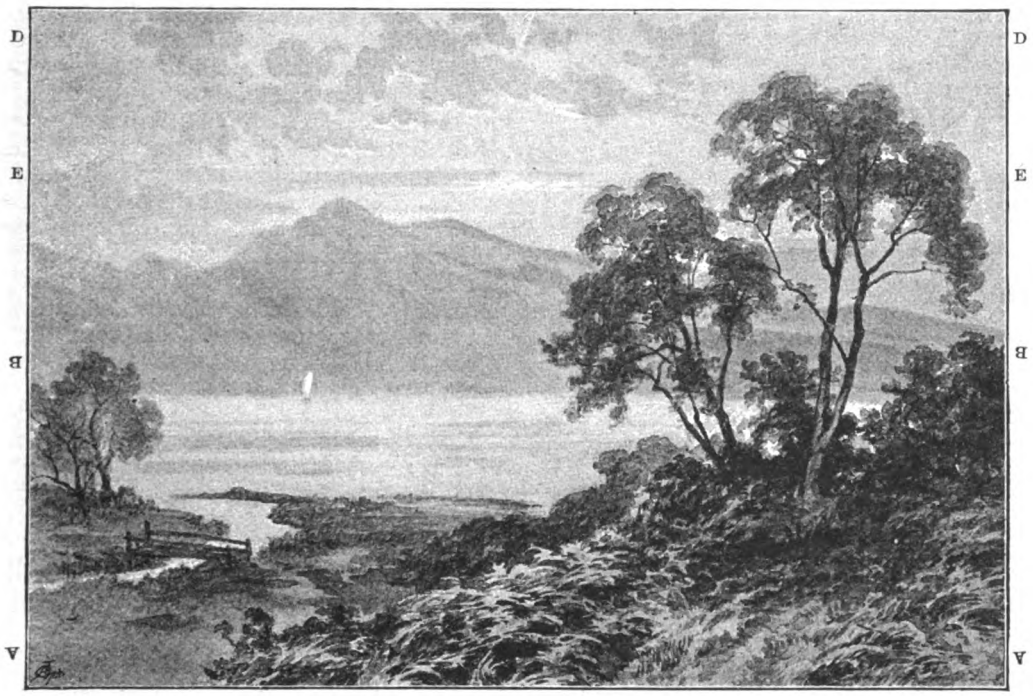
in the sky. When that is done, you come to the foreground. Everything here except the stream and the brighter parts of leafage must be washed with a pale mixture of burnt sienna and yellow ochre. Shadows hereabout are best rendered with a little sepia, some crimson lake and cobalt blue. Of these the proportion of sepia should be the least, because the resulting colour is a purplish grey, and this upon the burnt sienna and yellow ochre (which make a warm ground) will be sufficiently neutralised by a little sepia. The broad shadows which are on the dark tree require the same grey.

It may be after you have seen how the drawing is coming out that the sky appears in too low a tone. If this is the case, make a slight mixture of cadmium yellow and lake and with it go over all the sky down to the tops of the mountains.

A slight accident which is constantly recurring in water-colour drawing is rather prone to happen here: that is, the last wash may go over the mountain edges a little and produce a hard line. In this case, you must act quickly. Wet the parts affected with a brush of water only, blot them with ordinary clean blotting-paper and rub them very gently with a silk handkerchief—a useful thing to keep by you, by the way. To do this perfectly will only come with practice; but you can best learn that for yourself. If it is perfectly done, the original colour without the unsightly heavy line will be completely restored.

The last tint mentioned will probably be required on the water too. When you have brought it down as far as the light in the foreground break it off with a clean brush. When you have got the sky to your satisfaction, mix with the same tint last used a little more crimson lake and with this touch up the clouds. In the upper part of the sky a little grey should be added, which is what you will need for the darker clouds.

It will now be the foreground's turn. To gamboge and yellow ochre add a little indigo. With this composition paint the light parts of the grass and undergrowth.



An exercise which, carried out in colour, will help to demonstrate the difference between warm and cold tints and how two colours can help or neutralise each other.

Where you wish to define more accurately the shape of leaves and weeds, etc., indigo and brown pink will be found useful. These have the advantage of not destroying the effect of cool shadows which need to be in contrast and which give vigour to the warm lights. The dark trees should be touched in the first place with brown pink only. Be careful to keep inviolate the spaces where the sky shows through. Later, these trees can be made clearer and more distinct with indigo as well as brown pink.

These two colours make a very rich green, which is dark, and which is warm or cold according to the amount of indigo (in the former case) or brown pink (in the latter). The little trees on the left of the drawing should be of a colour which is a mixture of that used for the dark, large trees and of that used in the sky. They are distant and therefore misty and rather vague.

Notice that the white sail of a boat appears on the far side of the water. Do not *leave* this when first washing over the paper, but do it last,

by making the form of the sail with a clean wet brush, allowing the water to soak in for a moment and then drawing up what water is left with the blotting-paper. After that all you have to do is to rub the part thus treated with a little stale (and therefore hard) breadcrumb. The hull of the boat scarcely needs particularisation, but if you put it in, it should be grey, toning with the distance. Grey should also be used for the edge of the shore and those parts of any stones which are turned away from the source of light.

Do not regard this as anything more than an exercise. At the best it will not be a wonderful picture. No picture that does not spring from the artist's own eye and brain can possibly be. It is merely an exercise in the uses of colour, which will show you the difference between warm tints and cold ones and how two colours placed side by side emphasise or neutralise each other, as the case may be. J. G. B. L.

LIGHTING

As with the processes of warming which were discussed in the previous lesson, so with the means of lighting. It is an increasingly material age, when the pursuit of what is convenient and easy is on all hands described as sensible in order to mitigate the pangs of the artistic conscience.

The protagonist of modernity naturally finds some further excuse. He holds that a stalwart adherence to what is old-fashioned is retrograde: he points the finger of scorn at those who resist the influences of their age. In the matter of household lighting there is much to be said, however, for mechanical means. Electric light can at least be used attractively, though gas hardly ever.

Shaded Candles

But the old oil lamp gives a rich warmth and elementary and essential cosiness which neither of the other means can hope to provide, and candles alone are beautiful. Of course they give trouble—so do lamps. But that is at least part of my contention—one *ought* to be ready to give pains and trouble in the cause of elegance. I am not for one moment suggesting that it is the duty of every artist to light his house with candles: I am only suggesting that it is the most decorative of the means at his disposal. A multitude of candles in brass or copper or even iron candlesticks lights a room adequately and with a softness and reticence which can be obtained in no other way.

Candlelight, provided that there is enough of it, is the most agreeable to read by: and assuredly the best to feed by. A dinner-table lit by shaded candles, so that the whiteness of the cloth and the sparkle of silver and glass is accentuated and thrown into relief by the soft gloom above and around is unequalled by any, however cunningly arranged, artificial means. People forget the value of colour in a room of shadows. There is nothing essentially gloomy about it in the bad sense of the word. The candid glare of electricity reveals everything, and allows but few graduations of tone. Candles or lamps illuminate essentials and leave the rest in softly rising banks of shadow, catch unsuspected points of light, and draw them from obscurity—gently reveal rather than shamelessly expose.

Gas is hopeless save in the rarest cases. But electric light can be "managed." Big rooms are sometimes cunningly lit by hidden globes which run along the cornice. But the very fact of the means of light being hidden is in itself wrong. In all decorative questions the means should be seen or capable of being seen. Ruskin objected to pictures being hung with the cord drawn tight behind them and the nail out of sight.

Electric Globes

The means of hanging should be seen, he put it; and an apparent impossibility—that is, of a picture glued like a fly to the wall—was artistically immoral. It is the same with the means of lighting. So the only course to pursue with electric light is, not to disguise, but to palliate it. The bracket which holds the globe should be as simple as possible; the shades should also be simple. These are most effective when made of thin coloured silk before a strong lamp. The colour naturally depends upon the rest of the room.

A further word may be said on the subject of surrender to convenience. Some time back I read in a newspaper the description of what purported to be the personal experience of the author: one who, owning precious china and good old furniture, sold it because it was the most "sensible" course, and procured modern, strong, "work-aday" furniture which could be knocked about and used without care. Certainly such people are unfit to possess what is fine and good and valuable, but the point of view is rather sordid.

Here are people who, on their own showing, know more or less what is what and who prefer the comfort and ease of not having to look after it, who prefer the monetary gain the stuff produces to the stuff itself. It is not a very edifying spectacle. J.G.B.L.

Continued from page **56.**

BUSINESS AND COMMERCE:

***Contributors*:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).**

COMMERCIAL TRAINING
XXX

THROUGH all his intercourse with the public the salesman must be thoroughly patient.

Nothing should be too much trouble. Small orders are not to be despised. A sufficient number of small orders equals a large one.

Advertising may attract new customers just as an effective window display will do; but, from the moment the buyer enters the shop until he leaves, everything possible must be done to convince him of the advantages of dealing at the shop; the courtesy and attention he receives; and so on, in order that the true value of the advertising and window display may be gained to bring him to the shop again.

Salesman and Servant

And here may be mentioned the importance of handling child customers with tact. Children come to shops on the errands of their parents, and a child should receive much the same treatment as the adult; care being taken by the assistant to advise in difficulty, to win the confidence of the child, and to fill the order to the best of his ability.

Not only will the child thoroughly appreciate such attention and wish to come to the shop on future occasions; but children normally grow up, and the child emissary of to-day becomes the adult customer of to-morrow.

For very much the same reasons, servants should be treated with precisely the same courtesy as their employers. Servants move about from place to place; and, though no mistress asks the word or recommendation of her maid, the fact remains that no retailer can afford to offend anyone, even a servant maid; and everyone who enters his shop is a potential customer for large or small amounts, and should be treated accordingly.

There are many retailers who adopt devices other than advertising to bring custom to their shops. In certain districts and with certain types of shop, it is an excellent plan to run a sub-post-office as an adjunct to the business, so that people calling upon purely postal affairs may be induced to patronise the ordinary wares of the shop.

To establish a branch post-office it is necessary to obtain a prescribed number of local signatories; to find certain securities; and to obtain the licence of the authorities, full particulars of which may be obtained by writing to the postmaster of the local town or city, or from the Postmaster-General in London. In the same way, many small tradesmen obtain a licence to sell postage stamps; a useful draw to a small shop, in the obtaining of which there are but few formalities.

Roundsmen

So far as roundsmen are concerned, they should make it their business not to appear at the doors of their customers every morning with precisely the same remarks and outlook upon things. The smart roundsman is the one who takes with him occasionally some new line, some special bargain, or novelty, from the shop. He should introduce this novelty or attraction quite naturally; interesting the customer in it, and in most cases he will obtain an order that without such enterprise he would have missed.

Practically the same remark applies to the shopman, who should not allow it to be assumed that the shop holds nothing but the ordinary, everyday lines.

At the same time, there must be complete differentiation between customers. Where a new line in preserved fruits might lure an old gentleman, some particularly fragrant toilet soap might tempt a young lady, and so on; but not vice versa.

There *is* an opening for real brains in being a salesman; an outlet for the imagina-

tion in appealing to a customer, an art in selling without being offensive, in being pushful and keen without being discourteous.

And let the smart salesman come down to business a few minutes ahead of the "drudgery" salesman in the morning, so that he may make himself closely acquainted with the contents of the window. It frequently occurs that through misunderstandings the customer is able to inform the assistant as to the price of goods displayed in the shopfront; and this ought not to be with a clever assistant.

Moreover, there is such a thing as making a customer feel thoroughly "at home" in a shop. This end is not to be attained by slavish servility; but rather by a quiet, forceful, confident manner. We speak of a medical man being successful because he possesses a good "bedside manner"; in the same way, we may write of a salesman's good shop manners.

Trade Subtleties

The little niceties of life, the taking of a parcel or umbrella, the offering of a chair, the willingness to give change, the desire to devote one's time exclusively to the satisfaction of the one customer—all these points (and many more besides) are to be closely studied and acted upon by the salesman who would succeed.

We all know that much of the success of the auction-room depends upon the auctioneer's clever talk and "patter." From the time he occupies the rostrum until the sale is ended he is talking volubly, interesting his audience thoroughly in the particular article he is selling, giving the people the impression that he knows its true value but is not going to give it away, holding their attention and fascinating them at the same time.

The arts and subtleties of the auctioneer might well be transposed to the shop assistant who is eager to become an expert salesman; the ability to capture the imagination of the buyer, to compel his interest, and to convince him that he really needs the article to be disposed of.

Yet another aspect of good salesmanship lies in the manner with which customer's friends are treated. Many purchasers when visiting a shop have with them their personal friend; and, before an article is definitely purchased, it is of quite common occurrence for the opinion of the friend to be sought. At such a juncture as this the salesman must be doubly wary.

He must do nothing to offend the friend, or in the long run he will offend the customer too; and if the friend gives the casting vote against him he must accept it with good will and hasten to produce some article more in keeping with the friend's tastes and the customer's own requirements. **A. B.**

CHOOSING A CAREER.—XXXIV

The Scholastic Profession as a career demands from the worker, either man or woman, a great deal more than mere academic knowledge.

In the training of the young there is a very real and serious responsibility devolving upon the tutor; and the work itself is most exacting, calling for all the qualities of patience, teaching skill, and a knowledge of children and their ways that must to a greater or lesser extent be innate.

Certainly no one should attempt to become a teacher with the idea that the calling represents a life of comparative ease. The actual hours of teaching may be short and the vacations long, but the teacher's work is only half completed with the dismissal of the class; and not only has the work of the pupils to be supervised after school hours, but present-day education is developing so rapidly that it is necessary for teachers themselves to be constantly studying, that they may keep abreast of evolution, the newest plans and the most recent progress.

In studying the question of the scholastic profession as a career it will be advisable for us to deal first with the *Public Elementary Schools*. They are the outcome of the spread of national education and of the evolution from parochial and church schools and also from the Board Schools; and there are naturally more public elementary teachers than those of any other class.

And the thousands upon thousands of these teachers look for their appointments to the local educational authority. In no case are they appointed by the Board of Education. The local authority is generally constituted from a committee of the county, borough or urban district council; though, in a few instances, public elementary schools are under their own managers, subject to the local authority.

It will be obvious, therefore, that, before proceeding further with the work of studying to become a school-teacher, the student should communicate with the local education authority in order to ascertain precisely

what facilities are offered in the immediate neighbourhood for training; and also what prospects there are of future employment in the locality.

So far as the various grades of teachers are concerned, the Board of Education recognises the following: 1. *Pupil Teachers.* 2. *Student Teachers.* 3. *Uncertificated Teachers;* and 4. *Certificated Teachers.* There were also *Supplementary Teachers*, women engaged in special circumstances without the usual qualifications. Those Supplementary Teachers already in appointments are to remain undisturbed; but no new Supplementary Teachers will be engaged. There are also *Bursars*, i.e. pupils in secondary schools who are in training to become public elementary teachers.

The profession offers special opportunities to the man or woman of self-education; for, in the public elementary service, there is practically no call for University degrees; and the pupil at a public elementary school to-day may in the near future become a teacher. In fact, boys and girls of public elementary education will find that special facilities are granted to them for the training course to become teachers.

We may say then that the boy or girl may remain at a public elementary school until the age of 11 is attained. Then should follow four years' training at a secondary school; and, in the majority of cases, there are no fees to be paid at these secondary schools for pupils who have passed through the public elementary school.

In some instances the local education authorities establish a system of scholarships at the secondary schools for intending elementary school teachers; and, in certain cases, these scholarships include an allowance for the keep and maintenance of the student until he is able either to go to a training college or to support himself to some extent with the salary he will be earning as a teacher.

In other cases, where neither these facilities nor secondary schools are available, a centre is established for the training of pupil teachers, and even 14 years of age is not considered too young for the entering of these centres.

Pupil Teachers are those actually engaged in the tuition of very young children; and, at the same time, themselves studying with a view to accepting higher positions in the teaching world. Bursars are student teachers who are passing through the training curriculum without gaining actual experience in the art of teaching.

It is not necessary that pupil teachers or bursars shall pass a preliminary examination before commencing their period of training; but it is a rule of the Board of Education that all candidates coming forward shall be physically sound, and a medical certificate is required, whilst special attention is paid in this respect to the eyes, ears and teeth.

The boy or girl who leaves a public elementary school and passes on to a secondary school does not immediately commence the work of training for pupil teachership. This course of education as a rule commences at the age of 16; and the student must at all events be under 18 when this period of recognition begins. The period lasts for two years; but, in some circumstances, candidates are only called upon to pass a period of recognition of one year.

In other cases, as in rural districts where there are no secondary schools, this recognition period may commence at 14 years of age, in which instance the period lasts for four years. Pupil teachers who begin at 14, however, are excused from practical teaching work during the first year of their candidature.

In most cases a salary is paid to pupil teachers, the amount varying according to the particular district and to other circumstances; and at the close of the period of recognition there is an examination to be faced. This may be either the preliminary examination for the elementary school teacher's certificate, the Oxford or Cambridge Senior Local Examination or Matriculation; or merely an examination to qualify the successful participant for a two years' course at a training college.

Bursars, at the beginning of their period of training, must be over 16 and under 18 years of age; and have been educated for the three previous years at a secondary school. They have to fulfil the same conditions as to physical fitness as the pupil teachers; and must receive a favourable report from the headmaster of their secondary school.

In some circumstances a bursar may become a student-teacher and be employed as part of the staff of a public elementary school, the while he continues his own training; and he may remain in this grade for a period of one year; or, in unusual cases, for two years. To become a student-teacher, the candidate must be over 17 years of age and have passed an examination qualifying him or her to enter a training college.

At the close of this period, however, the student teacher may accept one of two alternatives—he may seek admission to a training college; or he may become an uncertificated teacher, in which case he will be eligible to accept appointment as a permanent assistant teacher at a public elementary school, though only in very small schools (those with fewer than 40 pupils) could he hope to become a head teacher.

So far as the training colleges are concerned, a great part of the cost of training is borne from government grant; though usually a small fee is charged to students by the authorities of the college. A list of training colleges, together with particulars of neighbouring hostels, details of fees payable and similar information, is obtainable by writing to the *Secretary of the Board of Education, Whitehall, London, S.W.*1.

A course at one of these training colleges and a successful issue from the final examination at the close of the course entitles the student to become a recognised and certificated teacher; and, at some of the training colleges, there are special facilities for those who would take certificates as specialist teachers in schools for deaf, blind, or mentally afflicted children.

All men and women who have qualified to act as certificated teachers are eligible to become members of the permanent staff of a public elementary school; but it is necessary for them to complete a given period of service before they can qualify to become headmasters or headmistresses.

One point that the would-be public elementary teacher should not overlook is the importance of spending a short time at all events as a pupil teacher or student teacher. The lessons learned and difficulties experienced during this period stand one in good stead at the training college; and a student who goes to a college equipped with a certain amount of experience is likely to view matters from a far more beneficial point of view than the student who has gleaned no practical working knowledge of the gentle art of teaching.

It is important that the mental equipment of the teacher should expand commensurately with the enlarging demands of the scholar. Practical aims have first claim to consideration in carrying out the school time-table, but the ideal of training the pupil to independent thinking must not be overlooked. The latter should appear as a definite aspiration to stimulate the minds of the pupils who may afterwards become teachers.

A. C. M.

BOOK-KEEPING.—XXVIII

We have already seen what is meant by a reserve fund, and have shown for what general purposes reserves are created. In some cases reserves are created merely for the purpose of providing generally for the future. This is an appropriation of profits, and would be shown as such in the appropriation account and in the Balance Sheet.

Secret Reserves

If it be considered advisable to accumulate reserves, it is not always desirable that competitors should know of the existence of such funds, or the particular purposes for which they were created.

It is usual in such cases to create what are known as Secret Reserves, which are appropriations of profit hidden under other guises, the object being to create a reserve without its appearing in the accounts.

If, for example, Investments are written down below their proper value, or fictitious liabilities are created, the effect is to create a hidden surplus not shown in the Balance Sheet.

There are advantages and disadvantages in secret reserves.

The advantages are:—

(i) They tend to produce stability in businesses which are liable to fluctuations in value of assets, e.g. where investments decrease in value owing to financial stress, a secret reserve from which to make good deficiency promotes confidence.

(ii) They are a means of protecting business from competitors.

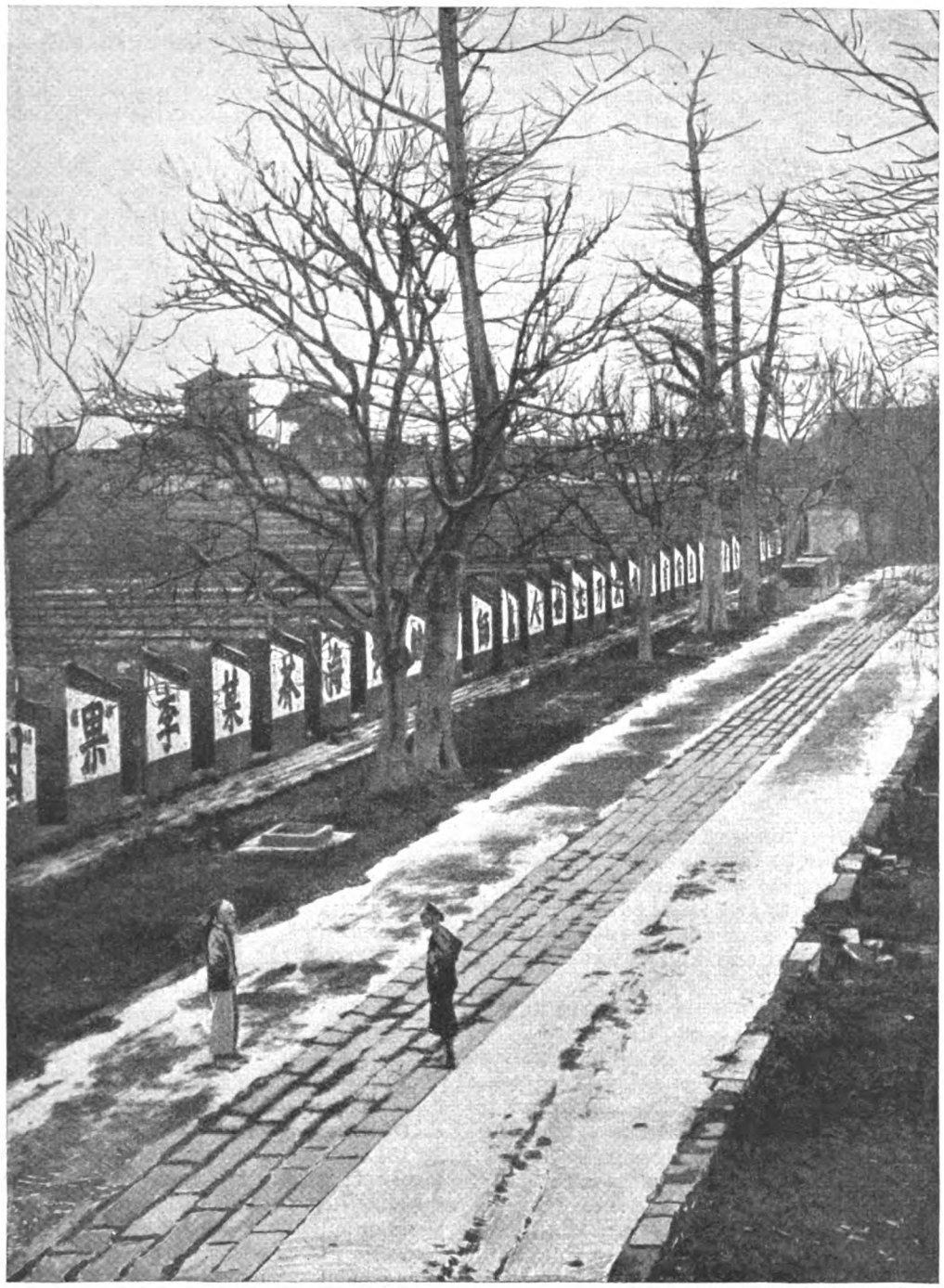
The disadvantages are:—

(i) The accounts of a Company creating such reserves are not correct records of the state of the Company's affairs. This disadvantage is counteracted by the fact that the affairs are better than shown.

(ii) The shareholders do not know the real state of affairs, but the auditors may disclose to them the exact conditions. This checks the manipulation of secret reserves for the purposes of covering defaults and mismanagement. Such reserves are most desirable, but the accounts are thereby deliberately false.

Secret reserves, it should be noted, are quite legal, but auditors cannot be bound by the Articles of Association not to disclose their existence, nor can they be silenced as to the use to which such reserves are put.

Where a reserve is created and invested outside the business it is sometimes



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CRIBS TO PREVENT "CRIBBING"

The above is a photograph of the great examination "hall" at Canton, where for centuries past the Chinese, with the wisdom of a very ancient civilisation, have confined candidates under examination each to his own cell. Not only must the candidate work in his cell, but also eat and sleep there, during the period of the examination.

called a **Reserve Fund** in contradistinction to a **Reserve Account,** or Reserve simply, which denotes a Reserve invested in the business.

Where, then, a **Reserve Fund** appears as a liability in the Balance Sheet it should be balanced by an equal amount of securities on the assets side. Some writers on Accounts do not quite agree with this, and contend that the place of investment is altogether immaterial.

Suffice to say that if the Reserve is created for a specific purpose and the desire is to use the money accumulated without interfering with the business, it is better to appropriate actual cash to the amount set aside for the purpose and invest it so that when the money is required the investments may be realised without interfering with the business, e.g. as in the case of a Depreciation Fund (Vol. IV., p. 246).

The purpose of the Reserve should be clearly stated in the annual accounts.

On the other hand, if the idea is to provide for future possible contingencies and promote financial stability, there is no object in investing outside the business at, say, $3\frac{1}{2}\%$, and at the same time borrowing money from debenture holders at 5%.

Sinking Funds

The idea of sinking funds has been explained fully under the name of **Depreciation Funds.** In the case of the **Depreciation Fund** the annual instalments were charged to Profit and Loss, but generally a sinking fund is intended for future use to repay a definite and known liability, e.g. debentures.

For this purpose it is not an ordinary charge against Profit and Loss but is an appropriation of profits.

Thus a sinking fund is either—

(*a*) An accumulated depreciation fund to provide for the renewal of an asset ; or

(*b*) An accumulated reserve raised for the repayment of loans or debentures.

In case (*a*) the summation of profits is eventually passed to the Asset Account to balance it, but in case (*b*) the accumulated profit will be transferred to the Capital Reserve Account.

The example we propose to give is a sinking fund to repay debentures. The annual instalment is charged to the Appropriation Account, but otherwise the procedure is exactly as in Lesson 22. We therefore give only two years of the Ledger Accounts and the final result *pro forma* (*see* page opposite).

Consider the following :—

A limited company issued 100 debenture bonds of £100 each at £95, repayable at *par* in ten years. Write up the Journal, Cash Book and Ledger to show the provision of a Sinking Fund accumulated at 5% compound interest and the repayment of the debentures.

Inwood's Tables show that ·079504 of a pound set aside annually for ten years at 5% per annum compound interest will produce £1.

£10,000 is produced by £·079504 × 10,000 = £795 0s. 10d.

The student is recommended to complete the Ledger accounts. In the last year the instalment may be a few pence short, as fractions of a penny are, of course, ignored throughout.

Any deficiency in the value of investments must be made good out of profits. The student will notice that provision is to be made for wiping out the debenture discount. This will be a charge against revenue equally apportioned to each year. The balance of the amount of discount will be shown as a fictitious asset in the Balance Sheet so long as any remains.

Exercise

The following exercise was set in the Senior Grade Examination of the London Chamber of Commerce :—

On January 1, 1912, the X.Y.Z. Company, Ltd., was formed, with a nominal Capital of £110,000, divided into 100,000 Ordinary Shares of £1 each, and 1,000 8% Preference Shares of £10 each. The shares were offered for public subscription, and 95,800 Ordinary Shares and the whole of the Preference Shares were applied for and allotted. On December 31, 1912, 12s. 6d. per share had been called up on the Ordinary Shares, being 5s. per share on application, 5s. per share on allotment, and 2s. 6d. per share on first call, which was made on March 1, 1912. With the exception of 7s. 6d. per share on 800 shares, the amount called up had been paid. The shares upon which there were calls in arrear were forfeited by resolution of the Directors on April 1, 1912. The Preference Shares were fully paid up.

In July, interim dividends were declared and paid at the rate of 6d. per share on the Ordinary Shares and 4% on the Preference Shares. Ignore all questions of Income Tax in connection with these dividends.

On December 31, 1912, in addition to the balances represented by the above transactions, the following balances appeared in the books of the Company (*continued on p.* 120):—

JOURNAL ENTRY EACH YEAR

Dr.				£	s.	d.	Cr. £	s.	d.
Year	1	Appropriation of Profit Account	Dr.	795	–	10			
		To Debenture Redemption Fund Account					795	–	10
		(Being annual sinking fund instalment)							

Note that the discount will not appear in the following accounts, as the debentures are repayable in full.

CASH BOOK

Dr.		£	s.	d.			Cr. £	s.	d.
Year 2	To Redemption Fund Account (Interest on first year's investment)	39	15	–	Year 1	By Investment Account (annual instalment)	795	–	10
					2	By Investment Account interest on previous year's investment plus instalment	795	–	10

Continuing for ten years on these lines.

LEDGER

DEBENTURES ACCOUNT

Dr.		£	s.	d.			Cr. £	s.	d.
10th year	To Cash	10,000	–	–	1st year	By 100 debentures of £100 each	10,000	–	–

DEBENTURE REDEMPTION FUND ACCOUNT

Dr.		£	s.	d.			Cr. £	s.	d.
1st year	To Balance c/d	795	–	10	1st year	By P. and L. Appropriation Account	795	–	10
2nd year	To Balance c/d	1,629	16	8	2nd year	By Balance c/d	795	–	10
						,, Cash (Interest)	39	15	–
						,, P. and L. Appn. Account	795	–	10
							£1,629	16	8

This continues as in the example in Lesson 22. In the 10th year we have:

		£	s.	d.			£	s.	d.
10th year	To transfer to Capital Reserve Account	10,000	–	–	10th year	By Balance b/d	–	–	–
						,, Cash (Interest)	–	–	–
						,, P. and L. Appn. Account	795	–	10
		£10,000	–	–			£10,000	–	–

DEBENTURE REDEMPTION FUND INVESTMENT ACCOUNT

Dr.		£	s.	d.			Cr. £	s.	d.
1st year	To Cash	795	–	10	1st year	By Bal. c/d	795	–	10
2nd year	To Bal. b/d	795	–	10	2nd year	By Bal. c/d	1,629	16	8
	,, Cash (Instal. and Interest)	834	15	10					
		£1,629	16	8					

This account again continues as in Lesson 22, but for 10 years. In the 10th year we have:

		£	s.	d.			£	s.	d.
10th year	To Bal. b/d	–	–	–	10th year	By Cash	10,000	–	–
	,, Cash	–	–	–					
		£10,000	–	–			£10,000	–	–

	£	s.	d.
Rent, Rates, Taxes and Insurance	2,298	5	9
Discount Account (Credit Balance)	59	4	1
Salaries	2,800	–	–
Directors' Fees	250	–	–
Sundry Creditors	4,899	–	7
Bills Receivable	422	6	7
Repairs	472	17	–
Advertising	9,660	–	–
Interest paid on Mortgage to December 31, 1912	112	10	–
Freehold and Leasehold Property	25,267	–	–
Office Expenses	1,644	2	3
Goodwill	14,000	–	–
Preliminary Expenses	411	10	–
Bad Debts	329	6	8
Sales	93,120	15	11
Sales Returns	1,510	11	4
Purchases	67,954	12	11
Purchases Returns	1,925	8	3
Plant and Machinery	6,721	15	1
Furniture and Fittings	2,978	13	4
Factory Expenses	247	14	5
Mortgage (4½%) on Freehold Property of Company	5,000	–	–
Transfer Fees	1	7	6
Carriage	1,202	7	5
Manufacturing Wages	11,222	1	1
Sundry Debtors	20,293	15	8
Lighting and Heating	115	15	–
Factory Fuel and Power	247	4	11
Cash at Bank	1,547	14	10
Cash in hand	95	12	1

(*e*) £2,000 to be written off Leasehold Property.

(*f*) 10% Depreciation to be written off Plant and Machinery.

(*g*) 5% Depreciation to be written off Furniture and Fittings.

(*h*) Stock on hand on December 31, 1912, was valued and certified at £11,168 16s. 8d.

(London Chamber of Commerce, Senior Grade.)

Importance of Revision

Before working the proposed exercise, read up the various points in previous lessons. Carefully consider the whole, not as a book-keeping exercise for examination purposes, but as a practical happening in a real business.

The object of book-keeping is to enable a man to know at any time the state of his monetary affairs, and also his financial relationships with others. It is only by becoming familiar, to the attainment of the habitual, with the principles governing the subject, that practical work can be done intelligently, and the chief object of book-keeping be attained.

		£	s.	d.	£	s.	d.
Profit and Loss	Dr.	411	10	–			
To Preliminary Expenses (Being whole written off)					411	10	–
Profit and Loss	Dr.	3,220	–	–			
To Advertising (being one-third written off)					3,220	–	–
Profit and Loss	Dr.	1,014	13	9			
To Bad Debts Reserve					1,014	13	9
Depreciation	Dr.	821	2	2			
To Depreciation, Plant, etc.					672	3	6
To Depreciation, Furniture, etc.					148	18	8
Rates and Insurance prepaid	Dr.	127	1	8			
To Rates and Insurance					127	1	8

You are required to prepare Trading and Profit and Loss Accounts for the year ended December 31, 1912, and a Balance Sheet as on that date, after taking into consideration the following :—

(*a*) Rates and Insurance paid in advance and unexpired were £127 1s. 8d.

(*b*) All Preliminary Expenses to be written off.

(*c*) Two-thirds of the expenditure on Advertising to be carried forward.

(*d*) A Reserve for Bad Debts to be created amounting to 5% on the Debtors.

Consider, in conjunction with Lessons 23 to 25, the details of entries to record capital, and by way of revision make the necessary Journal entries.

Make also Journal entries for the adjustments in the exercise, e.g.—

Now work the exercise as proposed.

Key : Debit Trading Account with Wages, Factory Expenses, Carriage, Factory Fuel and Power. **Gross Profit,** £23,830 8s. 9d. Net Profit, £8,527 19s. 5d. Balance after dividend paid, £5,752 19s. 5d. Balance Sheet Total, £85,227.

F. H.

Continued from Vol. IV., page 452.

HISTORY:

Contributors:—**J. A. Brendon, B.A.(Oxon.), F.R.Hist.S.; F. Collinson, F.R.Hist.S.; T. P. Evans, B.A.(Oxon.); James A. Manson; L. Stampa, M.A.(Oxon.); and J. B. Sterndale-Bennett.**

THE THIRTY YEARS WAR.

In the hope of ending the desolating strife between the Roman Catholic States of Germany and those States which were predominantly Protestant, representatives of both parties assembled at a Diet in Augsburg in February, 1555, and assented to a Religious Peace.

It was agreed that the toleration which had been extended to the Lutherans at Passau three years before should be reaffirmed, and that the rival creeds should be equally represented in the Imperial Chamber. A deadlock ensued, however, on the question of the disposal of Church property.

Sixteenth-Century Germany

In the Lutheran States such property had been secularised. The Catholics, however, bent on stopping this custom, stipulated that in future whenever a Roman Catholic prelate joined the Reformed faith he must resign his charge and all its contingent patronage.

On this point there was no room for agreement, and the President of the Diet, Ferdinand of Austria—destined a year later to succeed his brother Charles on the Imperial throne—took it upon himself to adjust the dispute out of hand by inserting in the Treaty not only the Ecclesiastical Reservation desiderated by his co-religionists but also the Lutherans' protest.

But there were two fatal flaws in this document. First, its concessions were devised for Lutheran consumption alone, the Calvinists—now grown an active and resolute body—being wholly ignored. Secondly, it contained no guarantee for liberty of conscience, each prince being free to settle the religious belief of his subjects. The former defect had far-reaching consequences, inasmuch as it set up a wall of partition between the two greatest Protestant communions in the Empire. This sense of separatism, moreover, lost none of its force through lapse of time, and became especially bitter on the part of Lutheran Saxony and the Calvinist Palatinate.

Ferdinand I. (1556–1564)—who, by the way, admitted the Jesuits into Germany, and thereby did the country incalculable harm—and his son Maximilian II. (1564–1576), although Catholics, were anxious, above all things, to keep the peace. With their immediate successors it was far otherwise. Maximilian's eldest son, Rudolf II. (1576–1612), wrapped up in alchemy and astrology and—to his honour—the patron of John Kepler and Tycho Brahe, espoused the Roman Catholic reaction; and the Protestants soon realised that they must help themselves or go under.

This was forcibly brought home to them by the treatment of Donauwörth, a Protestant Imperial Free town, the inhabitants of which had violently resented a Mass procession through their streets. For this fault the town was illegally placed under the ban of the Empire.

The Evangelical Union

What had happened to Donauwörth clearly might happen to any town. Accordingly at Ahausen, on May 4, 1608, the Protestant princes formed the Evangelical Union, under the Elector Palatine, Frederick IV., in defence of their political and religious liberties. The opponent princes retorted by founding at Munich on July 10, 1609, the Catholic League, entrusting the leadership to the Duke of Bavaria.

In his hereditary dominions of Austria, Bohemia, and Hungary, Rudolf II. placed himself implicitly in the hands of the Jesuits, and his rule proved so oppressive that in two of these kingdoms the people broke out into open revolt. The Hungarian malcontents invoked the help of the Turks, and in Bohemia—the country of John Huss and Jerome of Prague—the Protestants extorted a Majestäts-Brief, or Letter of Majesty (July 11, 1609), which granted them

toleration and certain limited privileges as to worship and schools.

These moderate concessions being ostentatiously evaded, Rudolf was deposed forthwith and his brother Matthias became King in 1611. The former dying next year, Matthias acquired the Imperial crown also (1612–1619). But he was infirm, no longer young, and quite unequal to the task of overcoming the difficulties which confronted him. Moreover, he was childless, and, to secure the succession, his family consented to support the claims of his cousin, Ferdinand of Styria, whom the Bohemian Estates were coerced into recognising as their king, *vice* Matthias resigned (1617).

For the Bohemians the choice was a fatal one. Ferdinand had not belied the promise of his youth. Educated, along with Maximilian of Bavaria, by the Jesuits at Ingolstadt, he had solemnly vowed, before the altar of the Madonna at Loretto, to restore Catholicism at any cost as the sole religion in his dominions.

"Impatient Bohemian Protestantism"

The Letter of Majesty was treated as if non-existent, the Reformed Churches were destroyed, and with wicked ingenuity every artifice was employed to goad the people into rebellion, in order to provide a pretext for wholesale extermination. At last the people *did* rise, appointed Count Thurn their leader, proceeded to the Castle of Prague, and flung Secretary Fabricius and two ministers, named Martinitz and Slawata, Ferdinand's underlings, out of the window of the council chamber—"hurled out by impatient Bohemian Protestantism," says Carlyle, "a depth of seventy feet—happily only into dung, and without loss of life."

This exploit, done on the 23rd of May, 1618, was the immediate prelude of the Thirty Years War.

Nothing further of outward significance occurred in 1618. Nevertheless, in Bohemia events were moving rapidly. Thurn recognising the necessity of forestalling the enemy and encouraging the spirits of his men, decided to assume the initiative. Accordingly, reinforced by a body of Piedmontese under Ernest, Count Mansfeld, he threatened Vienna. The defeat of Mansfeld, however, and a continuance of unseasonable weather obliged the Bohemians to retire.

At this juncture Matthias died (March 20, 1619). Ferdinand forthwith posted to Frankfort-on-Main, where (August 28) he was elected Emperor (1619–1637).

Two days earlier the Bohemians also held an election. They deposed Ferdinand, and chose as their king the Elector Palatine Frederick V., the head of the Evangelical Union, who—it may be added—did not solicit the uneasy crown.

This audacious deed enraged the Imperialists and the League alike. Frederick had scarcely an ally. Because he was a Calvinist, the Lutheran princes held aloof; his own Union left him in the lurch; his father-in-law, James I. of England, proved a broken reed. The Catholic League gave the command of its army to Count Tilly, one of the most skilful generals of the day and a zealous, saturnine Papist.

Ferdinand II

The rival forces met on the Weissenberg (the White Hill), to the north of Prague, on November 8, 1620, and the Bohemians were totally routed. Frederick fled—"winter-king, fallen in times of frost, or built of mere frost, a snow-king altogether soluble again," ejaculates Carlyle in clumsy, contemptuous mockery—and found such rest as was possible to him at The Hague.

At a single stroke Bohemia, Silesia, and Moravia were laid at the mercy of Ferdinand II. Had he been wise and just, the warfare might well have ended here—to his credit and renown. Ferdinand's fanaticism, however, was now thoroughly aroused and got the better of his judgment. In Bohemia his vow to the Virgin was literally fulfilled. The Lower Palatinate was ravaged by the Spaniards under the Marquis of Spinola. The Upper Palatinate was conquered by Maximilian of Bavaria, to whom also were transferred Frederick's Electoral privileges (1623). This last act was grossly unconstitutional; the Emperor never even consulted the Electoral princes, who were now beginning to reap as they had sown.

The putting of Frederick under ban of the Empire was another clear abuse of prerogative. But Ferdinand cared not what he did; he was riding a high horse recklessly—and riding for a fall since presently that horse was to bolt with him.

Superior in force, Carlyle alleges that he was "all along of great superiority in fraud," and got rid of several of his opponents in devious ways. After the defeat at the White Hill, the Evangelical Union, apparently conscious of its own shortcomings, was dissolved. The Piedmontese and other mercenary troops then took to harrying the lands of the Catholic princes. One body was led by Count Mansfeld, another by Christian of Brunswick, titular Bishop of

Halberstadt, and a third by George Frederick Margrave of Baden-Durlach. But it was the innocent people, not the princes, who suffered from the marauders on both sides—then, as always, throughout this prolonged and cruel conflict.

Christian of Brunswick had a chivalrous regard for Elizabeth, the ex-Queen of Bohemia, and used to wear her glove in his hat—" Bright lady, it shall stick there, until I get you your own again, or die ! " He failed to get Frederick's wife her own again, but he did not fail to die in a year or two—by poison, administered, it is sometimes said, at the instigation of the Emperor. Yet in spite of all the retaliation which the Leaguers' savagery provoked, Ferdinand had the better staying power and wore down the bulk of opposition.

Success, it seemed, had turned Ferdinand's head. Hitherto the war had mainly partaken of its original character—a not too glorious encounter between Protestants and Roman Catholics. North Germany had only half-heartedly supported the cause for which the Bohemians had manfully shed their blood ; while South Germany, under the leadership of Austria, had eagerly placed all its resources at the disposal of the Catholic League.

Henceforth the struggle was to wear a more distinctively political aspect. Ferdinand gave a loose rein to his ambition, and began to dream dreams and see visions. From the Alps to the North Sea all Germany appeared to lie at his feet, and he was obsessed with schemes of aggrandisement such as even Charles V. in his palmiest days would hardly have entertained.

From the picture by Karl Wurzinger.

THE EMPEROR FERDINAND II. REFUSING THE PROTESTANTS OF GERMANY THE LIBERTIES FOR WHICH THEY ASKED.

The act which plunged Central Europe into the horrors of the Thirty Years War. Educated by Jesuits, Ferdinand, who became Emperor in 1619, had sworn to restore Roman Catholicism at any cost as the sole religion in his dominions.

The Laodicean princes of North Germany became uncomfortable, and France viewed with grave suspicion the menaced increase of Habsburg power. At this stage, therefore, Cardinal Richelieu—Louis XIII.'s Minister of State—intervened, and succeeded in concluding an alliance with England by arranging (1624) a treaty of marriage between the King's sister and the Prince of Wales, who became Charles I. in the following year.

The famous French statesman thus check-

mated Philip IV., who aimed at winning the Prince for his own sister the Infanta and so securing the support of the English crown. But other sovereigns outside of Germany were concerned in the issue, notably Christian IV. of Denmark (1588–1648), an able king, though Carlyle insists that he was a drunkard

After the portrait by Van Dyck.

COUNT ERNEST MANSFELD (1585-1626).

A mercenary soldier who rendered invaluable service to the Protestant princes during the early part of the Thirty Years War.

also, and Gustavus Adolphus, the warrior-king of Sweden (1611–1632), a stalwart Protestant, a soldier-born, whom Napoleon considered as one of the world's eight greatest generals. Gustavus had a Polish war on his hands at the time. The English king, therefore, who had to find the money, assigned the new leadership of the Protestant cause to the Danish monarch (1625), who, as Duke of Schleswig-Holstein, and therefore a prince of the Empire, was directly interested in resisting further encroachments.

Ferdinand saw that his work was cut out for him. He had but one army, that of the League, commanded by Tilly. Not only had he to meet the force under Christian, but he had to deal with the guerrilla warfare still carried on by Count Mansfeld and Christian of Brunswick, while Gabriel (Gabor) Bethlen, the independent Prince of Transylvania, who had, off and on, supported the Protestants in the east for several years, again threatened mischief. Moreover, his purse was empty.

Just when the outlook was at its worst the *deus ex machina* appeared in the person of Albert of Waldstein or Wallenstein (1583–1634), the Duke of Friedland, a man of Destiny, enormously rich, and inordinately ambitious; a great soldier, moreover, who offered to raise and equip, free of charge, an army of 50,000 men, provided he were entrusted with the sole and absolute command. Ferdinand jumped at the offer.

The autumn and winter of 1625 were spent in comparative repose and the campaign opened in the following spring. The two Imperial generals carried everything before them, Wallenstein defeating Mansfeld at the bridge of Dessau in April, and Tilly routing Christian IV., hopelessly outnumbered, at Lutter-in-Barenberg on August 17. Nor was this the full tale of the Protestant disasters. Mansfeld retreated towards the south-east, but the terrible Wallenstein hung

After the portrait by Van Dyck.

ALBERT VON WALLENSTEIN (1583–1634),

Duke of Friedland, the brilliant soldier who commanded the Imperial armies with conspicuous success until he was finally mastered by Gustavus Adolphus at Lützen in 1632.

on to him like a leech and relentlessly hunted him through Moravia and Silesia into Hungary, where the unfortunate Count joined Gabriel Bethlen, but even then was held on the defensive. Bethlen's zeal, moreover, had declined, and Mansfeld deemed it prudent to separate. He made for Venice, but had only reached Zara on the Dalmatian coast when he fell ill and died (November

30, 1626), worn out with toil, anxiety, and defeat.

Next year Wallenstein was at the flood of success. The very stars—in which as a student of the occult he firmly believed—in their courses seemed to fight for him. Gabriel Bethlen, his Turkish allies being otherwise engaged, was a negligible quantity; England had fallen out with France, and Charles, at loggerheads with Parliament, could remit no money to Denmark. Wallenstein's return from Hungary by way of Silesia (the reduction of which had gained him the Duchy of Sagan) could be traced not by victories, for he was seldom molested, but by the baleful track of devastation caused by his soldiers. When he joined forces with Tilly the combined army proved irresistible. The Elector of Brandenburg humbly submitted; Mecklenburg was occupied and the Duchy conferred upon Wallenstein the grandiose title of Admiral of the North and Baltic Seas. Continental Denmark also was overrun.

From the portrait by Van Dyck.

GUSTAVUS ADOLPHUS,

King of Sweden (1611–32), who, as the champion of Protestant Germany, proved himself one of the greatest soldiers the world has seen.

Yet had the League deep misgivings. Tilly, its general, had played a subordinate part in the recent campaign, in which Wallenstein, the Emperor's general, had won all the glory. Moreover, though Wallenstein was a Catholic, sectarian quarrels and controversies had not the smallest attraction for him. He was a statesman first and foremost, and was even credited with the gorgeous design of creating one Germany, one Emperor, one law, and one army.

The princes of the League felt that his political scheme would reduce them to nonentities. Cordially hating Wallenstein, they urged Ferdinand to dismiss him.

But the Emperor scouted the idea of parting with the man whose services had been so valuable. In 1628 Wallenstein with unabated confidence resumed his plans.

To subjugate the Scandinavian kingdoms he must have sea-power, and he had fixed upon Stralsund as a desirable harbour for the navy which he proposed to call into being. Seizing Pomerania without ado, he started to build warships at Rostock and then laid siege to Stralsund (1628). The townsfolk put up a most stubborn fight, with such assistance as Gustavus Adolphus sent to them, and after six months Wallenstein was compelled to admit his first serious reverse, in spite of his tall talk, "I will have the town, if it hung by a chain from heaven!"

Wallenstein had had to conduct the siege unaided, the League having declined (through Tilly) to furnish the additional force of which he stood in need and which, in point of fact, he had asked his former comrade in arms to supply. The significance of the rebuff was not lost upon one who had mastered the maxim that "All things come to him who knows how to wait."

The failure at Stralsund was principally owing to want of a navy to co-operate with the manœuvres by land. Christian IV. discovered this in due course, for venturing to cross swords again with Wallenstein on his own element after the latter's defeat, he was again beaten and obliged to accept the Peace of Lübeck (May 12, 1629), under which those of his territories which had been

From the picture by W. Marstrand.

KING CHRISTIAN IV. OF DENMARK AT THE BATTLE OF KOLBERGE HEATH (1644),

when, though sixty-eight years of age, wounded in thirteen places, and blinded in one eye, he remained fighting on the quarter-deck of his flag-ship the *Trinity* until at last darkness separated the Danish and Swedish fleets.

occupied (and desolated) by the Imperial troops were restored, provided he relinquished his son's bishoprics of Verden and Bremen and refrained from interfering any more in the affairs of Germany. Humiliating as were these conditions they might, quite obviously, have been worse. However hard it was thankfully to receive from a conqueror's hands his own provinces, with their ruined homes and weeping people, he might have been stripped of them altogether.

Ere his course was run Christian was to play a truly mean and despicable part.

Ferdinand now determined to put the finishing touch to the Counter-Reformation by issuing (March 6, 1629) the Edict of Restitution. This involved spoliation on the grand scale, for it commanded the Lutherans to restore to the Roman Catholic Church all the property—archbishoprics, bishoprics, abbacies, and monasteries—which had been secularised, since the Treaty of Passau.

Protestant Germany in Arms

"It was a *coup d'état* as furious," says Alfred Michiels, in his *Secret History of the Austrian Government*, "as if the French were now to be asked to restore the clerical property seized during the Revolution."

To promulgate the Edict despotically and carry out its provisions by force or fraud, would give the Catholics in the Diet such a preponderance of voting strength that the whole work of the Reformation would be undone at a blow. That some such result was contemplated was proved by the clause empowering Catholic landlords to compel their vassals to adopt their religion or emigrate. The Edict rudely awakened John George, Elector of Saxony, and George William, Elector of Brandenburg, out of their serenity; while the few Protestant princes who had borne the burden and heat of the day prepared once more for battle. Ferdinand had overreached himself.

The princes of the League saw that, whether the Church benefited little or much by the Edict, the Emperor's position would be indefinitely enhanced. They knew that he owed more to Wallenstein than to themselves and felt that he might soon become independent of them. They were unwilling, therefore, to promote his dynastic or personal ends and at the same time surrender such authority as still remained to them.

The danger to their own interests was imminent, and self-preservation was the first law of Nature. Accordingly, Maximilian, the Duke of Bavaria, convened a meeting of the League at Heidelberg, which demanded, in effect, that Ferdinand should dismiss Wallenstein and disband his army. The North German princes who were not members of the League also pressed a like suit, because Wallenstein's troops had proved a veritable scourge.

Ferdinand grudgingly agreed to discharge 18,000 men, hoping he might hear no more of the other article.

But the princes of the League were not to be hoodwinked. At another meeting, held at Ratisbon in June, 1630, the request for Wallenstein's dismissal was peremptorily repeated and supported by the whole Electoral College, the Protestant princes, and the ambassadors of France and Spain.

It was essential that Ferdinand should avoid dissension, as he was then anxious to secure the election of his son as King of the Romans so that he might succeed to the Empire. He gave way. Wallenstein was cashiered, and Tilly took his place.

Meanwhile Gustavus Adolphus had made peace with Poland (1629) after eight years' intermittent fighting. He was incited thereto by Richelieu, who again deemed it expedient to check the vaulting ambition of the house of Habsburg, and who recognised in the Swedish King the man who should offset the Emperor.

Gustavus Adolphus

Gustavus was quite ready for action on the Continent. As a convinced Protestant, he viewed with stern disapproval the efforts of Ferdinand and the League to crush the cause. As a patriotic king, who had faith in Sweden's future, he was anxious to secure her maritime strength on the Baltic coasts. He was, therefore, not at all averse from readily responding to Richelieu's diplomacy.

Sustained by the acclamation of his folk, who idolised him, he sailed with 15,000 men and landed on the island of Usedom on March 24, 1630. He was welcomed by the German peoples, but not by the German princes.

The aged and childless Duke of Pomerania agreed that in return for aid in clearing out the Imperialist troops who had been living on it, Sweden should hold the province as security for her expenses in the war.

This task Gustavus accomplished with businesslike ease. But the Electors of Saxony and Brandenburg still stuck to their fatuous neutrality. They did, indeed, summon a convention of Protestant States at Leipzig in February, 1631, but the gathering took three months to do nothing beyond petitioning Ferdinand to revoke the Edict of

Restitution, a prayer to which no heed was paid. A little judicious pressure at Berlin satisfied the Elector of Brandenburg that his favourite theory of peace at any price had its limitations, and Gustavus helped himself to the towns of Spandau and Cüstrin of which he had temporary need.

Siege of Magdeburg

Unhappily, while he was thus hampered and delayed, the city of Magdeburg, which had been in a condition of siege more or less throughout the winter—some twenty-eight weeks in all—fell before a vigorous and unexpected assault by Tilly on May 10, 1631, and was given over to the tender mercies of an infuriated soldiery.

Thirty thousand victims perished in the sack and countless numbers, besides, flung themselves into the Elbe to escape indescribable outrages.

Brandenburg and Saxony between them must share the eternal disgrace of holding up Gustavus and preventing him from advancing to Magdeburg's relief. But even supine John George of Saxony at last gladly accepted the Swedish alliance when Tilly threatened to raid his dominions. Gustavus, at length free to move, swept to avenge Magdeburg, and, on September 7, 1631, completely defeated Tilly on the plain of Breitenfeld, a mile or so north of Leipzig.

Had Gustavus adopted the advice of his Chancellor, Axel Oxenstierna, and pushed on to Vienna, he might have dictated terms to Ferdinand in his own capital. Apparently he had not grasped the full import of his recent victory, and dispatched John George of Saxony into Bohemia (where the Elector's army occupied Prague) and himself proceeded towards South-West Germany.

In vain Tilly attempted to intercept his march, which was virtually a triumphal progress. Almost everywhere he was welcomed. Weimar, Gotha, Erfurt, opened their gates to him, and the Ecclesiastical States—"the Priests' Row"—from Bamberg by Würzburg (whose bishop incontinently fled to Paris) to the Rhine, expecting to be paid back in Tilly's coin, were amazed at his moderation. He entered Frankfort-on-Main in splendid state (November 17, 1631) and received the Protestant princes like a German Emperor "all of the olden time." At Mayence, where his Queen—sister of the *fainéant* Elector of Brandenburg—joined him, he held high Court. Here the Catholics made overtures of peace. His terms included the withdrawal of the Edict of Restitution, toleration for both Protestants and Catholics in town and country, the restoration of Frederick V. to the Palatinate and to his Electoral vote, and banishment of the Jesuits.

According to some authorities, he also stipulated that he was to be elected King of the Romans with the reversion of the Empire. Whether his ambition soared so high is a moot point, but in any case these conditions were unpalatable and the war was resumed. Advancing into Bavaria, he found Tilly in position on the Lech, with the object of disputing his progress, and at once offered battle, on April 5, 1632. The League sustained a heavy defeat, Tilly being mortally wounded at Ingolstadt on April 30.

Gustavus was speedily master of all Bavaria, excepting Ingolstadt—whose strong fortifications could not be reduced without wasting more precious time than the town's unimportance justified—and he pitched his camp close to Nuremberg.

Was Vienna to be his objective ?

Battle of Lützen

In dire distress the Emperor turned to the only man who could serve him in his extremity. After repeated entreaties Wallenstein at length consented to aid him, but on his own terms. His command was to be absolute and independent. Never again would he expose himself to another wanton affront. His control in military affairs must be supreme and unquestionable, even by the Emperor; neither the League nor the Court clique in Vienna must presume to interfere with him; an Austrian dignity should be conferred upon him; and he must have jurisdiction over all the territories he should conquer. If Ferdinand did not like these terms he could leave them. They formed a bitter pill, but the Emperor swallowed it.

Wallenstein's name acted like a spell. At the magic of it an army of 50,000 men assembled in three months. Clearing the Saxons out of Bohemia, he hastened to Nuremberg, where he tried to cut off supplies and so far succeeded as to oblige Gustavus, as the result of an engagement in which the latter was worsted, to break his camp. Ascertaining that Wallenstein had then invaded Saxony, Gustavus bade farewell to his Queen at Erfurt, and hurried, by forced marches, to the Elector's relief.

The two armies met at Lützen on November 6, 1632. Before beginning the fray the Swedes sang Luther's hymn, "Eine feste Burg ist unser Gott," and then, at Gustavus's cry of "Onwards!" joined issue. The

DAME FASHION,

as she sported herself in Britain, 1, in Saxon times; 2 and 3, in the days of the Normans; 4, 5, and 6, under Plantagenet rule; 7 and 8, while the Houses of York and Lancaster vied for supremacy; 9-12, in Tudor times; 13 and 14, in the seventeenth century; 15 and 16, in the eighteenth century; 17-21, in the nineteenth century; and 22, in the twentieth century. The figures in each period are numbered progressively in order of date. (*See* pp. 173, 174.)

fortunes of the day swung from one side to the other, as each commander made a bid for victory. Gradually, however, the Swedes were gaining the ascendancy, when the sudden arrival of reinforcements under the Imperialist, Pappenheim, caused them to waver. While rallying his troops Gustavus received a mortal wound.

The news of this disaster spread like wildfire and revived the drooping spirits of his men, now bravely led by Bernard of Saxe-Weimar, who had valiantly supported the king ever since he landed. Burning for vengeance, they made several desperate charges, and when night fell Wallenstein withdrew to Leipzig, the Swedes remaining in possession of the field. But the life of Gustavus was a heavy price to pay for a success which, however brilliant or amply earned, was not in itself decisive.

After the Swedish king's death Oxenstierna undertook the direction of affairs. The character of the war, however, sensibly altered and the Swedish soldiers, whose conduct while their king was at their head had been irreproachable, rapidly degenerated.

At first their arms were successful. They captured Ratisbon (1633) and devastated Bavaria, the cradle of the League, so effectually that Duke Maximilian implored Wallenstein for help. The latter turned a deaf ear to Maximilian's appeals, for he regarded the Duke as the author of his disgrace and meant to get a little of his own back.

Death of Wallenstein

It is alleged that he went so far as to meditate treachery, even offering to join the Allies and oppose the Emperor if, in return for his services, he were made King of Bohemia. In Wallenstein's excuse it has been argued that these were only tricks of the trade, *ruses de guerre*, and known to be such by the Protestant generals and declined by them for that very reason. At all events, though the stars did not warn him of it, Wallenstein had shot his bolt. The jealous Emperor was weary of his independent airs; the man, once useful, had now become a nuisance. Accordingly, on February 25, 1634, he was treacherously murdered at Eger, in Bohemia.

Thus miserably perished the mysterious Wallenstein, incomparably the greatest man on the Catholic side. Yet, after this bloody deed, success for a while attended the Emperor. His son, the King of Hungary, afterwards Ferdinand III., was appointed generalissimo; though really Matthias Gallas, a much abler commander, was in responsible charge of the Imperialist campaigns. As a result of his activities, the Swedes were driven from nearly all the places they had lately captured, including Ratisbon, and were doomed to suffer at Nördlingen (September 6, 1634) a defeat so disastrous that it went far to neutralise the whole of what Gustavus had achieved in South Germany.

Bernard of Saxe-Weimar and his colleague Gustavus Horn led the Northerners in the battle, the issue of which cost the Swedes some 12,000 men and vast stores of *matériel*, while Horn was taken prisoner. But in a measure this great reverse cleared the air; it relieved the Swedes of the dead weight of the North German princes, whose apathy and discord had done more harm than the swords of the enemy.

Peace of Prague

In May, 1635, it seemed good to John George, the Elector of Saxony, to contract a separate treaty—the Peace of Prague—with the Emperor. Ferdinand consented to modify the Edict, substituting 1627 for 1552 as the date at which restitution should begin, but refused to allow the Calvinists to share in the bargain. Despite Swedish protests against betrayal, the Elector of Brandenburg, the Duke of Mecklenburg, several other princes, the Hanseatic towns and the majority of the Imperial cities accepted the shabby compromise. "Miserable Peace" is Carlyle's caustic comment, "bit of Chaos clouted up, and done over with Official varnish—which proved to be the signal for continuing the War beyond visible limits, and rendering peace impossible."

It is difficult to understand how these princes and cities consented to the leadership of such a man as John George of Saxony, save on the principle that "Birds of a feather flock together." To Carlyle he was "a man of no strength, devoutness, or adequate human worth; who proved, on these negative grounds, and without flagrancy of positive badness, an unspeakable curse to Germany."

Determined that his country's sacrifices should not be stultified, Oxenstierna now turned to Richelieu for succour. The war then underwent another radical change. The French statesman helped to save the Protestantism of North Germany, but his main concern was to clip the wings of Austria and annex Alsace and certain of the Rhine towns. The Swedish Chancellor had no choice but give the Cardinal a free hand, but before returning home in 1636 he placed

John Baner in charge of the Swedish forces and provided for the defence of Pomerania, more than ever precious as security for the great outlay Sweden had incurred in this war.

Oxenstierna had displayed rare zeal and sagacity as well as indomitable pluck in carrying out Gustavus's programme, and continued to direct from Stockholm with unerring discretion the policy of the progressive Protestants in Germany. As it happened, however, things did not prosper with either Swedes or French for a while. The former were driven back almost to the Baltic and France was invaded; but presently there was a fine recovery on both fronts. Baner won a brilliant victory at Wittstock on October 4, 1636, and, thus encouraged, ravaged Saxony and Thuringia.

On February 15, 1637, Ferdinand II.'s pernicious reign closed. His son succeeded, and if Ferdinand III. were not so capable as his father, he was nevertheless an ardent Catholic, though less amenable to the Jesuits' influence, and had seen enough of the miseries of war not to be obstinately averse from peace. Events and circumstances, however, forced his hands, and he had to carry on to the end. But the year of his accession, owing partly to this fact and partly and more especially to general exhaustion—which was to be experienced henceforth periodically until it became the controlling factor of the situation—passed in comparative quiet.

Thwarted Strategy

In the following year Bernard of Saxe-Weimar (who had transferred his services to France a couple of years before) exhibited remarkable energy, seizing Rheinfelden, Freiburg and Breisach. He was credited with designing to form a principality for himself on both banks of the Rhine, but death arrested him at Neuburg on July 8, 1639, and his army, and Alsace along with it, passed into the keeping of France.

Baner, meanwhile, had not been idle and was soon to distinguish himself by a project the conception of which still dazzles one with its audacity. The new Emperor had summoned a Diet at Ratisbon in 1640 to discuss the immediate conduct of the war, a definite result having now become of paramount importance. Even the most stubborn of the ringleaders was convinced of the necessity of putting a period to the ceaseless drain upon the resources of the Empire, to say nothing of the wickedness and scandal of inflicting an infinitude of appalling cruelties upon the wretched peoples of the German and Austrian dominions. Why not, thought Baner, end the whole business while the Diet was in session, by capturing the Council, Emperor and all? No sooner thought than attempted. It was mid-winter and none would suspect him of quitting his quarters. The plan was put into execution, but Nature played the traitor. A sudden thaw set in, and the ice-bound rivers which should enable him to strike the blow had given place to impassable streams (January, 1641). Retreat became inevitable, and during this strategic movement the daring and dashing Baner passed away.

Sweden's Brilliant Soldiers

Baner's place was filled by a man of still more brilliant parts, the most consummate strategist of the several able generals whom Gustavus had trained. This was Leonard Torstenson, now thirty-eight years old. Though virtually an invalid, owing to the rigour of his six months' confinement in an underground dungeon at Ingolstadt, after the fight at the Nuremberg encampment nine years before, and almost always so crippled that he had to be carried about in a litter, his will-power and intellectual energy were such that they overcame his physical weakness. His resourcefulness nonplussed, as his rapidity of movement paralysed, his enemies, and his marvellous activity was a potent factor in bringing the final peace to pass.

He began his independent command by coming to terms with the new Elector of Brandenburg, Frederick William, a vastly different man from his father, whom he succeeded on November 21, 1640. The Great Elector, as he became, abandoned the timid policy which had cost his State so dearly, and slowly but surely devoted himself to restore its influence and fortunes, not averse from doing the Protestant cause a good turn when occasion served. He knew a true man when he met him; hence his truce with Torstenson.

The latter next conducted incursions into Silesia, where he defeated the Austrians at Glogau and Schweidnitz. He then cleared Moravia of most of the Imperialist forces, and, when hardly pressed in Saxony by the Archduke Leopold (afterwards Emperor) and Octavio Piccolomini, turned and rent them at Breitenfeld (November 2, 1642), the scene of Gustavus's triumph over Tilly in 1631. This victory set him free to pursue next year his operations in Moravia and Austria.

Foiled by such versatile strategy, Ferdinand III. had recourse to stratagem, and

From the picture by W. Rauber.

Gustavus Adolphus asking for God's blessing before the great battle in which the Swedish king measured his strength against and triumphed over Wallenstein, but—

From the painting by C. J. Wahlban.

—the battle cost Gustavus Adolphus his life. While rallying his troops at a critical stage in the fight, he was mortally wounded—a heavy blow to the Protestant cause.

BATTLE OF LÜTZEN, NOV. 6, 1632.

found a tool in Christian IV., now long past middle age and perverse enough to besmirch his good name by helping his old-time adversaries out of spite. He was induced to create a diversion by invading Sweden, of which he had never been too friendly a neighbour. Torstenson, however, quickly brought him to reason. Hastening northwards with wonted celerity in September, 1643, he broke into Holstein and in six weeks reduced the Danish mainland, with the exception of the fortresses of Rendsburg and Glückstadt, though the Danish king had to wait nearly two years for the formal peace from which he derived all the comfort to which he was entitled. Gallas followed in hopes of penning up the ever-victorious general in Jutland, but the Austrians could not cope with their nimble antagonist and were obliged to run, a total rout at Jüterbog in Brandenburg (November 4, 1644) quickening their pace.

Despite the follies of his later years, Christian IV.'s part in this war has been famous in Danish story and song. Army after army he raised; fleet after fleet. And the example which he set during the naval battle of Kolberge Heath was magnificent. Although 68 years of age, wounded in thirteen places, and blinded in one eye, he remained on the quarter-deck of his flagship, the *Trinity*, until darkness finally intervened between the Danish and the Swedish fleets.

French Co-operation

Though Gallas paid the usual penalty of failure, his successors fared no better, Hatzfeld being so soundly thrashed at Jankau on March 6, 1645, that the Emperor found it expedient, along with the Empress and most of the nobility, to flit from Vienna for change of scene. Still unsparing of himself, Torstenson next year essayed the task of capturing Brünn, the Moravian capital, but owing to the dogged defence and an outbreak of pestilence among his men, he had to raise the siege. His herculean efforts had overtaxed his strength—never, as we saw, robust—and he was compelled to retire from active service, returning for rest to Sweden, where Queen Christina and the people gave him a right royal reception.

He had not laboured in vain. Two years later the goal he had aimed at was reached, and he was satisfied.

While the Swedes were "doing their bit" France had not been idle. Richelieu had died in 1642 (December 4) and Louis XIII. followed him six months later, but Mazarin continued his master's policy of co-operation with the Swedes. The warlike measures were organised by the great Condé and Marshal Turenne.

Despite his youth, the former pulverised the Spaniards at Rocroi on May 19, 1643, the victory shattering for ever the tradition that the Spanish infantry was invincible; while Turenne defeated the Bavarians at Rottweil in the following year. In 1645 Francis Mercy, the Austrian general, smartly taking advantage of a blunder of Turenne's, beat him at Marienthal on May 5, but the Marshal had his revenge at Nördlingen three months afterwards (August 3), when Mercy was killed.

With Bavaria at his feet, Turenne joined hands with the Swedish general, Charles Gustavus Wrangel, who had taken over the command vacated by Torstenson, and resolved to detach Duke Maximilian from the Habsburg interest.

Peace of Münster

The Duke found himself in a dilemma. He was much more anxious about himself than about his Imperial master, and extremely desirous of conciliating France so that no difficulty might arise concerning the Upper Palatinate. When, therefore, the two commanders began to lay waste his territory, he was glad to accede to a truce at Ulm (March, 1647) lest a worse fate might befall him. He did not keep faith, however, and courted the defeat at Zusmarshausen (May, 1648), which terminated his double dealing and the Thirty Years War. For the capture of Prague by the Swedes under Hans Königsmark in July only pointed the moral which Ferdinand III., in his isolation, had already duly pondered.

Since 1644 congresses had sat intermittently at Osnabrück and Münster, two towns in Westphalia, chosen to avoid any friction between the Catholics and Protestants, and any disputes about precedence between France and Sweden. The Emperor negotiated with France, Spain and the German Catholics at Münster, under the mediation of the Pope, and with Sweden and the German Protestants at Osnabrück, under the mediation of the King of Denmark, the eventual agreement being comprehensively known as the Peace of Westphalia.

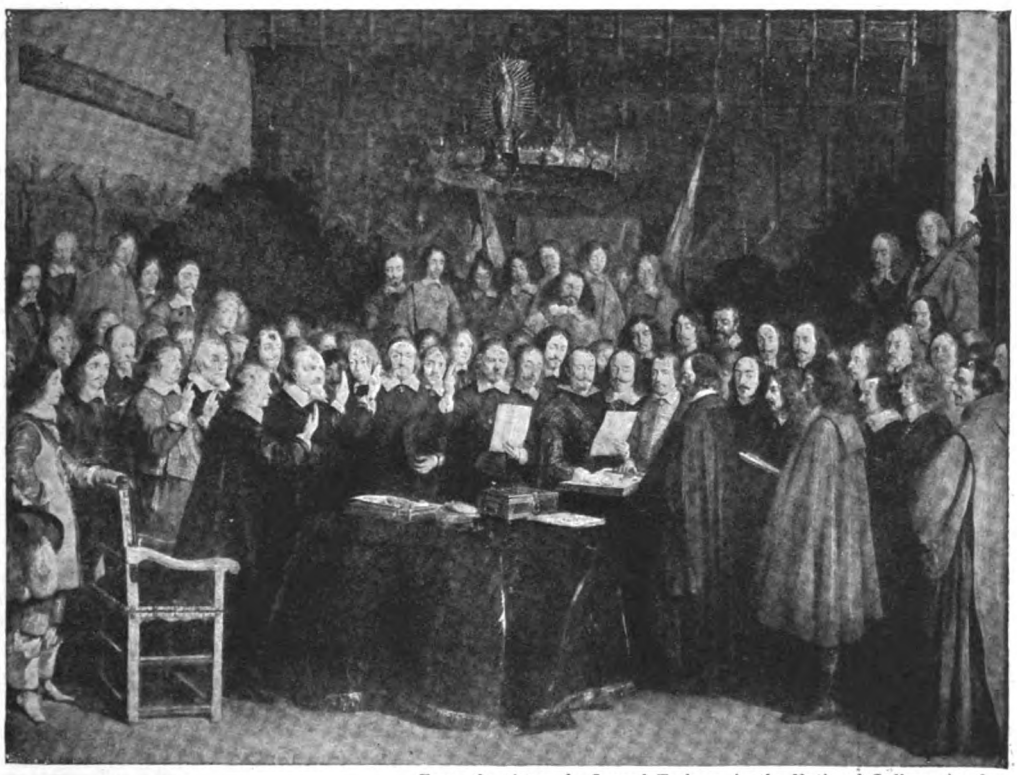
For the final session the envoys necessarily sat in common, the treaty being signed at Münster on October 24, 1648.

The settlement partook of a twofold character—religious and political. As regards the former, the Passau treaty (1552)

and the Augsburg Religious Peace (1555) were confirmed; benefices were to remain with the Church which possessed them, in the Palatinate, Baden and Würtemberg in 1618, and in the rest of the Empire in 1624; the Reformed (that is, the Calvinists) were placed on an identical footing with the Lutherans; and all religious persecution in Germany was forbidden. Politically, the main points were, recognition of the sovereignty and independence of the different German States (which postponed the ideal of German unity for more than two centuries and a quarter); the ban of the Empire could only be exercised with the consent of the Diet; the Lower Palatinate was restored to Frederick V.'s son Charles Louis, for whom an Electorate was created; Bavaria acquired the Upper Palatinate; Alsace, saving Strasburg, was ceded to France and note was taken of her previous acquisition of Metz, Toul, and Verdun; Sweden received, besides other areas, Hither (or West) Pomerania, Rügen with Stettin, and an indemnity of five million crowns, to be paid by the Empire; while Brandenburg, which had striven hard to obtain all Pomerania, to which, other things being equal, she had a strong right, had to be satisfied with Farther (or East) Pomerania and the secularised bishoprics of Magdeburg, Halberstadt, and Minden. The independence of the United Provinces was recognised by Spain and that of Switzerland by the Empire.

Since the Pope's agent Fabio Chigi (afterwards Alexander VII.) had withdrawn as a protest against the spoliation of the Church, and Christian IV.'s mediation had been barred by his contemptible war with Sweden in 1644, the Treaty was concluded under the sole mediation of the Republic of Venice, with France and Sweden as guarantors for its execution. France, Sweden, and the Protestants were thus the real and almost the sole beneficiaries by the Peace.

Of the closing phases of what must be regarded as a long drawn out crime against humanity, Carlyle has painted a painful pen-picture to which one may append as footnote Oxenstierna's aphorism in his letter to his son:—"You do not know, my son, with how little wisdom men are governed." J. A. M.



From the picture by Gerard Terburg, in the National Gallery, London.

THE PEACE OF MÜNSTER.

The signing by the accredited representatives of the belligerent States of the peace which, on October 24, 1648, at last freed Germany from the horrors of the Thirty Years War.

Continued from page 84.

SCIENCES:

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ELECTRICITY AND MAGNETISM.—XXI

Heating and Lighting Effects.—Whenever an electric current flows along a circuit some of the electrical energy is changed into heat owing to the resistance of the circuit to the passage of the current. If the resistance offered is very great, light as well as heat may be produced. Any conductor, no matter how great its conductivity, offers *some* resistance, so that a certain amount of heat is always produced.

Experiment 62.—*To show that heat is developed in a simple circuit.*

Take an ordinary dichromate, or other fluid cell, a yard of copper wire, and a thermometer. Ascertain the temperature of the solution in the cell before the current is allowed to flow.

Remove the thermometer from the solution, and if the temperature of the liquid differs from that of the surrounding air, allow the mercury in the thermometer to become steady.

Next wind the middle portion of the copper wire several times around the bulb of the thermometer in such a way that the turns of wire do not touch one another. Fasten the free ends of the wire to the terminals of the cell and allow the current to flow for several minutes. Note the behaviour of the thermometer. Evidently heat is developed in the external circuit.

Remove the thermometer from the wire but allow the current to continue. Let the mercury in the thermometer become steady and then take the temperature of the liquid in the cell. Is it the same as it was before the current flowed ? This experiment shows that heat is generated in both parts of the circuit.

Certain factors concerned with the production of heat in a circuit are almost self-evident.

Does the amount of heat produced increase when the resistance of the conductors is increased ?

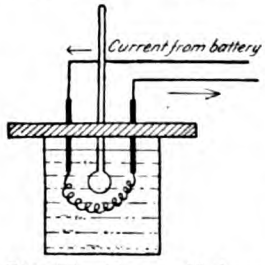


Fig. 75.—To see if there is any relation between the amount of heat developed in a circuit and the time the current flows.

To answer this question we must perform simple experiments with wires having different resistances.

Experiment 63.—*To see if the amount of heat produced bears any relation to the amount of resistance of a circuit.*

Obtain a good current from two or more cells connected in series. Coil the yard of copper wire used in the last experiment around the thermometer bulb and send the current along the wire for a definite period of time, say three minutes.

Remove the zincs from the battery, allow the thermometer to regain the temperature of the air and then repeat the experiment, using one yard of very thin copper wire, being careful to let the current flow during a time exactly equal to that which elapsed in the case of the thicker wire. Note the results as indicated by the thermometer. Perform similar experiments, using equal lengths of thick and thin iron wire, and any other wires you may have. Give the battery and thermometer a rest after each experiment, otherwise the current may alter, in which case the readings of the thermometer may be misleading.

Tabulate your results.

From these experiments we learn that the greater the resistance of a circuit the more heat is developed.

How does the time during which the current flows influence the amount of heat produced?

Experiment 64.—*To see if there is any relation between the amount of heat produced and the time a current flows.*

In a thin piece of wood about three inches square bore three holes, the middle one large enough to allow the thermometer to be inserted. Through each of the other holes pass a piece of thick copper wire, the lower ends of which are about one inch below the wood and connected by means of a coil constructed of thin iron wire previously wound around a pencil. Rest the wood holding the wires and thermometer on the open end of a small cup containing sufficient water to cover the coil of iron wire. Connect the

remote ends of the copper wires to the terminals of an accumulator or as many cells as you have at your disposal joined in series. Note the time and temperature when the current started, and observe the rise in temperature per minute. Can we say that the heat developed in the circuit increases in direct proportion to the increase of time during which the current is allowed to flow?

We have seen that resistance and time are factors concerned in the production of heat in a circuit. Is it not likely that the strength of the current is another factor?

Experiment 65.—*To observe the relation between the current strength and the amount of heat produced in a circuit.*

Construct three coils of equal resistance by using one foot of thin iron wire of the same gauge for each. Arrange them immersed in equal quantities of water contained in small vessels, as in Fig. 76. Each vessel must be composed of the same substance as the others, glass for instance. The connecting wires should be of thick copper, and the circuit arranged as shown in the figure. The temperature of the different portions of water should be the same when you start a strong current from an accumulator, or cells joined in series, flowing along the circuit.

Allow the current to flow for some time, and while

Drawn by S. W. Clatworthy.

ELECTRICITY AS A SAVER OF LABOUR

is coming more and more to the fore. The above semi-diagrammatic representation of the dining-room in the All-Electric House at the 1920 Ideal Home Exhibition at Olympia demonstrates some of the possibilities of electricity as man's quick and silent servant.

this is taking place note the rise of the mercury in each thermometer.

Does one of the thermometers indicate a more rapid rise of temperature than either of the others? Evidently the amount of heat developed in each

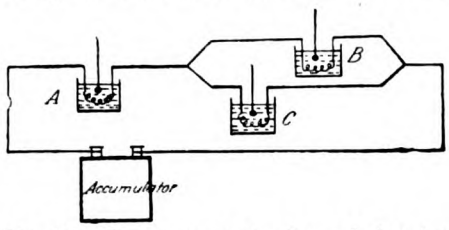


Fig. 76.—To demonstrate the relation between the current strength and the amount of heat produced in a circuit.

vessel is not the same. The temperatures indicate that four times the amount of heat is being developed in A as in either B or C. Now the current in A is twice that flowing through either B or C, since B and C form two pathways of equal resistance for the current to traverse. Suppose that the current flowing through A is two amperes, then one ampere will flow through B and one through C. But the heat developed in A is not merely twice that produced in B or in C, but four times the amount. Now the square of 1 is 1 and the square of 2 is 4. *Hence the amount of heat developed in a circuit is proportional to the square of the current strength when the resistance and time are constant.*

We may express the results of our experiments upon resistance, time and current strength in their relation to the heat developed in a circuit by means of the formula :—

$H=C^2R\ t$, in which H represents the amount of heat developed, C the current strength, R the resistance of the current, and t the time during which the current flows.

The relation $H=C^2R\ t$ is known as Joule's Law, after Dr. Joule, who investigated the relation between work and heat.

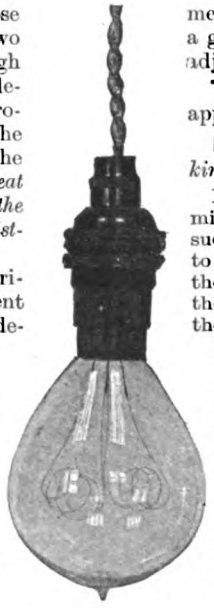
In all of the above experiments a strong and constant current must be used, and this should be obtained from an accumulator if possible.

The incandescent electric lamp is a practical result of the conversion of electrical energy into light.

Experiment 66.—*To observe the heat developed in a small piece of very thin wire.*

Introduce about one inch of very thin platinum (or iron) wire in a circuit composed of thick copper wires conveying a good current from an accumulator or several cells. The wire becomes red hot if it is thin enough, and if the current is of sufficient strength.

The temperature of the platinum wire has been raised sufficiently to cause it to emit light.



INCANDESCENT ELECTRIC LAMP. **The object of having no air inside is to prevent the chemical action which would otherwise take place between the air and the hot wires.**

The ordinary electric lamp used for domestic and other lighting purposes consists, in the more modern types, of several strands of very thin metallic wire placed inside a glass globe from which the air has been removed by a pump. Connection is made with the outside circuit by means of platinum wires which form an air-tight arrangement when let into the glass. The outer ends of the platinum wires are attached to metallic studs which serve as a contact for connection to the main circuit.

The light is "turned on" by pressing down a metal switch which then bridges over a gap in the circuit, and so allows the current to flow through the lamp. The object of having no air inside the glass bulb is to prevent chemical action which would otherwise take place between the air and the hot wires. Should the current flowing along the circuit be too strong, the connecting wires may become dangerously hot, and the filaments in the lamp may be injured, hence *fuse-wires or "cut outs"* are included in the circuit. These consist usually of wires composed of pure tin mounted on non-inflammable material, such as porcelain. If the current becomes too great the fuse wire melts, thus stopping the current by creating a gap in the circuit. The current can be adjusted and a new fuse-wire inserted.

The electric arc lamp is a practical application of the formation of sparks.

Experiment 67.—*To produce a certain kind of electric spark.*

By means of a copper wire connect one terminal of a good cell to a rough piece of metal, such as a file. Connect a second piece of wire to the other terminal of the cell, and draw the free end of the wire along the file. Notice the sparks produced. The rough file causes the contact to be broken at various places, with the result that just before contact is destroyed much heat is produced at the minute connection, and a small portion of metal volatilises with the formation of a luminous spark.

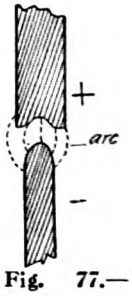


Fig. 77.—PRINCIPLE OF THE ARC LAMP.

The action of the arc lamp is somewhat similar to the formation of the spark in this simple experiment, but in place of metal conductors two pointed rods of prepared carbon are used for the production of a highly luminous arc-shaped "spark." If, when the current is switched on, the two carbon rods are even a very small fraction of an inch apart, no current flows, and no spark is produced. The carbons must be in contact when the current starts, and then if they are withdrawn from each other a slight distance, say one-eighth of an inch, some carbon is vaporised by the extreme heat produced, the intervening space becomes conducting, and the current crosses the gap with the production of the highly luminous "Arc."

The process of bringing the carbon rods into

contact at the commencement of the current flow and then separating them slightly is known as "striking the arc." When the lamp is emitting light the carbons are gradually consumed, so that the gap between them becomes larger. An automatic device brings the carbon rods together again.

Arc lamps may be used with either direct or alternating currents, but if the former kind is used the positive carbon, or that by which the current enters the lamp, will be consumed at about twice the rate the other is consumed, since particles of carbon pass from the positive rod to the negative. There are two types of arc lamp used in street lighting, the open kind in which the lamp, although enclosed in a glass globe, has free access to the air, and the close pattern in which the air is completely shut off from the carbons.

A definite voltage is required before a current will flow through an arc lamp of either type, upwards of eighty volts being necessary in the case of the closed kind, and about forty-five volts for the open type.

Other practical applications of the heating effects produced by current electricity include cooking stoves, electric flat-irons, etc. L. M. P.

BOTANY.—XV

42. Minute Structure of a Leaf.—The most instructive section of a leaf is one which is made transversely; and in order to study it the student should carefully make the following experiment:

Fold the leaf a few times and squeeze it firmly between two pieces of carrot; then cut, as though the object were to cut a section of the carrot, when of course thin strips of the leaf will be included.

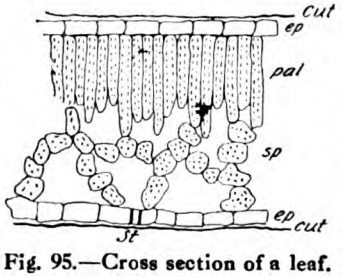


Fig. 95.—Cross section of a leaf.

Cut. = cuticle; pal. = palisade layer; sp. = spongy layer; ep. = epidermis; st. = stomate.

Mount a few of these and note the following points:—

A section made transversely shows (1) that the upper and lower sides of the leaf are covered by a thin membrane, the *cuticle*, which is not composed of cells; (2) that below this is a single layer of flattened cells, with watery contents, the *epidermis*; (3) that between the two layers of upper and lower epidermis is the *mesophyll*, or leaf-parenchyma, which is the main substance of the leaf. One or more veins will also be cut across, and obviously they are very different from the mesophyll.

In most leaves the mesophyll itself is readily distinguished into

(*a*) The *palisade layer* on the upper side, and

(*b*) The *spongy layer* on the lower side.

The cells of the palisade parenchyma are roughly rectangular in shape, and are all arranged with their long axes perpendicular to the surface. Intercellular space is scanty or absent. Each cell contains a number of conspicuous green bodies, called the *chloroplasts*, which are very often to be found arranged along the long walls of the cells. The cells of the mesophyll are smaller and contain fewer chloroplasts; they are oval in shape, irregularly disposed and leave very large intercellular spaces.

A fortunate section may show a stomate as an opening through the lower epidermis into one of the large intercellular spaces.

A very little reflection will show the remarkable adaptation of structure to function revealed by such a section. The cuticle protects the leaf against excessive loss by evaporation. The epidermis is probably a cooling layer. The compact palisade parenchyma prevents loss of light, and the arrangement of the chloroplasts assures that all can obtain at least some light. The very important aeration of the leaf is provided for by the spongy mesophyll. The modifications of these parts in such leaves as those of pines or water-lilies are well worth special study under the microscope.

DEMONSTRATION XXIX

To examine closely the nature of the epidermis, fold a leaf firmly round the forefinger and cut a superficial section of the underside. It can be cut so thin as not to include any of the green cells beneath.

The cells of the epidermis are now seen to be large and of irregular outline, without intercellular spaces. But the most conspicuous objects will be the stomates, which appear as small slit-like openings between two small sausage-shaped cells, called the *guard cells* of the stomates.

It is upon the action of these guard-cells that the aperture of the stomate depends. When they are turgescent, it is large; when the cells lose their water, they fall limply together and the stomate is closed. A slight thickening of the walls of the guard-cells on the lips of the stomate behaves like a cap on a football bladder, producing a depression when the cells become turgescent.

A vein has the structure of a vascular bundle to be described presently. The bundle may be observed, however, to be surrounded by a layer of special cells by which the water is conveyed from the vessels to the parenchyma of the leaf. We may notice in most leaves also the presence of

small thick-walled fibres which hold the vein above and below, and assist it in its function as a support for the leaf. If a vein is cut lengthwise, the presence of spiral vessels is easily ascertained, showing that the veins are really similar to the vascular bundles of the stem, and indeed continuous with them.

43. Minute Structure of a Stem.—In order to obtain full information concerning the nature of a stem, three sections are usually necessary: viz., a transverse section across the stem; a radial section, cut lengthwise along a radius of the stem; and a tangential section, also cut longitudinally but at right angles to the radius. The first two are the most valuable.

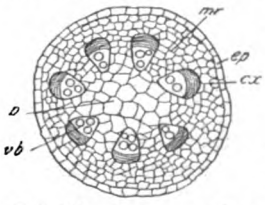


Fig. 96.—Cross section of stem of Sunflower.

mr. = medullary rays; cx. = cortex; ep. = epidermis; v.b. = vascular bundles; D = pith.

1.—As an example of a herbaceous stem, a young sunflower is useful.

A thin transverse section will show the following points (Fig. 96), among others :—

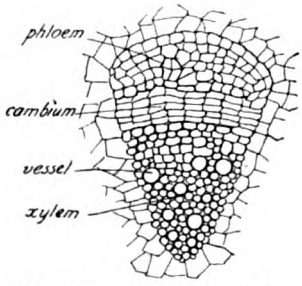


Fig. 97.—Single vascular bundle.

(i) The *pith* is composed of parenchyma tissue, the cells of which are large, thin-walled and empty; they are often broken down during cutting, and in older stems before that.

(ii) The *medullary rays*, between the vascular bundles, are also composed of parenchyma, but the cells are smaller and may not have lost their contents.

(iii) The *cortex* is continuous with the medullary rays, and similar to them. But the outer cells contain chlorophyll, and sometimes they are thickened at the corners, forming a band of *collenchyma* tissue. Outside the cortex is a single layer of epidermis which may in this case contain chlorophyll. From the epidermis arise the hairs which are very numerous on this stem. True hairs are always epidermal structures. In the cortex certain open spaces may be noticed among the cells; these are resin passages.

(iv) The *vascular bundles* form a definite ring round the stem, not far from the surface. In connexion with these it is easy (Fig. 97) to distinguish :—

(*a*) The *xylem*, adjoining the pith. Its chief constituents are the vessels, recognised by their large size and thick, well-defined walls. The vessels are arranged radially, with the smaller ones inward. Among them are to be seen small, thick-walled elements (*fibres*) and thin-walled parenchyma cells, these latter especially abutting on the medullary rays.

(*b*) The *cambium*, consisting of a few layers of thin-walled cells, flattened tangentially. A special point should be made of observing this part of the bundle in stems of different ages. It is a formative layer; new cells are formed by tangential division, and these become modified into xylem or phloem. There is therefore less cambium in an older stem than in a young one.

(*c*) The *phloem*, consisting of a crescentic mass of thin-walled cells, closely-packed. The most characteristic type is the *sieve-tube* whose ends are perforated with fine holes; but it is not often that these are caught in a transverse section. The outer part of the phloem is a band of sclerenchyma or fibrous tissue, a strengthening and protective band which extends to the epidermis.

A radial longitudinal section throws light on the nature of the vascular bundle especially.

From this (Fig. 98), we can study particularly well the nature of the xylem vessels. The pitted, spiral and scalariform types are all common, the spiral more frequently among the older central vessels. The fibres are seen to be elongated, tapering cells, forming a sort of padding among the vessels. The tendency of all the cells in the stem is, indeed, towards elongation in the direction of the stem's length; this is very marked in the fibres.

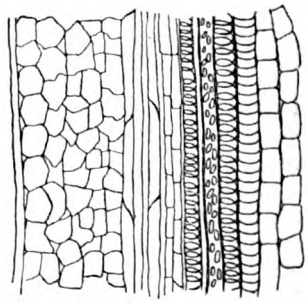


Fig. 98.—Radial section of stem of Sunflower.

DEMONSTRATION XXX

If a section is to be preserved, it should be mounted in glycerine jelly. It is also instructive to examine sections mounted in Schultze's solution. This enables us to distinguish between those which

have cellulose and those which have lignin in their walls. It also enables us to discover which cells retain their protoplasm: e.g. the contents of the sieve-tubes show an exceptionally deep stain, as do certain small cells contiguous to them, known as *companion-cells*.

Many other points can be made out by a careful observer; but they should be ignored at first, until these broad features are mastered.

Sections should also be made of the following stems, which are to be compared with the sunflower: Wallflower, Deadnettle, Pink, Grass, Water-Lily (or other water-plant).

Sections should also be made near and at a node, including the leaf-base, so that the passage of the vascular bundles into the leaf can be observed. The structure of a petiole should be compared with that of a stem.

2. For the study of woody stems, twigs of the lime, of various ages, are especially suitable.

The operator must not expect to obtain in one section anything more than a small

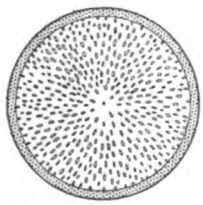


Fig. 99. — Cross section of stem of Maize.

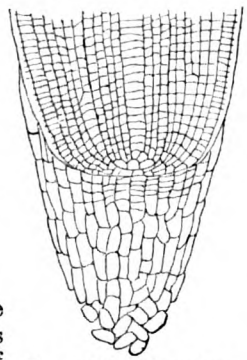


Fig. 100.—Growing Point and Root Cap.

portion of the stem; he must make a synthesis of his observations of several sections.

The older stem will show, as contrasted with the herbaceous type, the obliteration of the pith and cortex; the presence of bark, as previously studied; the reduction of the cambium to a narrow strip, so slender that the section always breaks at that point; the large increase in the xylem. The *annual rings* in the wood are seen to arise from the juxtaposition of the compact autumn wood and the next year's looser spring wood. The medullary rays are narrow in the xylem, but broaden out in the phloem which is still composed of crescentic patches. Moreover, short *secondary medullary rays* may be observed starting from the cambium and penetrating a little distance into the xylem or phloem.

If sections are stained with carmine, eosin, or other dye, the presence of protoplasm in the sieve-tubes, in the cambium cells and in those of the medullary rays can still be observed, showing that these are the only living parts in the adult stem.

3. The stems of monocotyledons (cereals, grasses, sedges, lilies, palms) differ very strikingly from those of the dicotyledons hitherto studied. They (Figs. 99, 100) are often hollow, but when solid they are composed of a mass of parenchyma, in which the vascular bundles are embedded, apparently in no definite arrangement, except that they

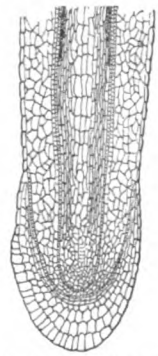


Fig. 101.—Long-section of growing point of root.

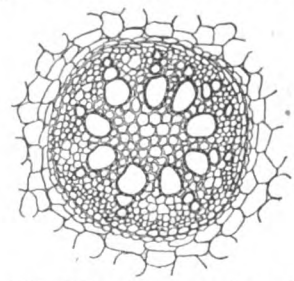


Fig. 102.—Cross section of root.

Fig. 103. — Long-section of growing point of stem.

are more numerous near the outside of the stem. Each bundle is closed by a definite layer of small cells, and contains xylem and phloem, but no cambium. Hence there is no secondary growth in thickness in such stems. Nor is bark formed; but in perennial trees its function is carried out by the accumulating, persistent leaf-bases.

Demonstration XXXI

Soak some stems of maize, wheat, lily, sedge, in spirits for twenty-four hours, and examine them microscopically in transverse and longitudinal section. Also compare microscopically the leaves of these plants with those of dicotyledons which have been previously studied.

44. Minute Structure of Roots.— The microscopic study of the root is a more perplexing and difficult problem than that of the stem (Figs. 101, 102). But the beginner can make out a few points for himself, by a suitable choice of material. Transverse and longitudinal sections should be obtained from a very young root (e.g. the radicle of a bean), from a tough slender fibrous rootlet (e.g. of a common buttercup) and from a tap-root like that of the dandelion or carrot.

It will then be noticed : (i) that the root-hairs are but outgrowths of the walls of the epidermal cells.

(ii) That the innermost layer of the cortex is well marked, as a ring of starch-containing cells, with characteristic black spots on their lateral walls, known as the *endodermis*.

(iii) That the outer layer of the vascular centre is also a well-defined special layer, the *pericycle*, from which the root-branches take their origin.

(iv) That the xylem and phloem occur in isolated alternate groups round the circumference, instead of radially, as in the stem.

The cambium does not arise as it does in stems ; but the result of its activity is to make the older root more and more like a stem in structure. The endodermis and the pericycle both occur in young stems, but even there are not so definitely marked as in the root.

Longitudinal sections of the growing points of stem and root should also be made. In the root the root-cap is the conspicuous feature, as a few layers of small compact cells. In the stem the origin of the young leaves can be beautifully followed (Fig 103). At the growing-point proper, there is no trace of vessels. Nevertheless, it is easy to distinguish in that of the stem three distinct kinds of rudimentary cells—the *dermatogen* or young epidermis ; the *periblem* or young cortex ; and the *plerome*, the parent of the vascular and other central tissues.

45. These stray hints on the use of the microscope will have served their purpose if they have indicated to the beginner in botany the wide and prolific field that lies open to him for further fascinating study. Here we wish him to gather from it also a conception of the cellular structure of the plant. The plant is an aggregate of living and dead cells. The dead cells fulfil mechanical but necessary functions only ; the living cells collectively form the living plant. Each of the living cells lives its own life, but is dependent on its neighbours for one thing or another ; only those which contain chlorophyll, for example, can manufacture the indispensable starch. Each cell is formed by division from a previous cell, in the growing tissues.

The subsequent fate of the cells varies ; the cells of the cambium, the pith and the xylem remind us of the different possibilities. They may retain their power of division ; they may lose their contents entirely and become obliterated ; or they may devote their contents to the thickening of their walls, and thus die usefully. E. W. E.

GEOLOGY.—I

Scope of the Subject. — Geology is the science which is concerned with the structure and history of the earth. It investigates the composition and arrangement of the rocks to which access is possible. It inquires into their origin and into the changes which have taken place on and below the earth's surface during our planet's history.

Geography limits itself to a description of the earth's surface as it now is. Geology attempts to reproduce from the record of the rocks the geographies of past ages, and to trace their gradual evolution from the remotest times up to the present day. Geography deals with the outlines of land and sea as they *are*—it is static. Geology is essentially concerned with the processes whereby the present configuration has been arrived at—it is dynamic. In studying the rocks in which the earth's history is written and preserved, one of the most fundamental discoveries was that of fossils, relics of animals and plants which formerly inhabited the earth. Thus, it comes within the province of geology to write the history of the evolutionary chain of life which, from simple beginnings, has culminated in the highly specialised organisms of to-day.

Geology claims the rocky framework of the earth as its own storehouse of facts. Yet in so extensive a science it is necessary to call in the aid of many other sciences. We must turn to astronomy for knowledge of the earth as a planet ; to physics for a better understanding of the energy of the earth—both the internal energy which is the heritage of its far-off origin, and the external energy with which it is supplied by the sun ; to chemistry for all the help the laboratory can give us in determining the composition of rocks and minerals ; to biology for a knowledge of the plants and animals which now inhabit the earth ; to all of these and more we turn for information and assistance.

Geology itself is, for convenience, divided up into a number of important branches, all of which ultimately converge towards the final aim of the subject—the elucidation of the life history of the earth.

Dynamical Geology deals with the agencies occupied in the formation and alteration of rocks and with the origin and evolution of land forms.

Petrology deals with the rocks and ore deposits which build up the crust of the earth, their mineralogical and physical characters, and their origin and decay.

Structural Geology deals with the structures produced in rocks by movements within the earth.

Palæontology deals with the relics of plants and animals of former times.

Stratigraphy deals with the order and succession of geological formations, groups them according to time periods, and utilising evidence culled from all the other branches of the subject, attempts to unravel and interpret the history of the earth.

Economic Geology stands apart as the application of geology to mining, engineering, agriculture, building, etc. It deals especially with mineral deposits, fuels, building materials, and water supply.

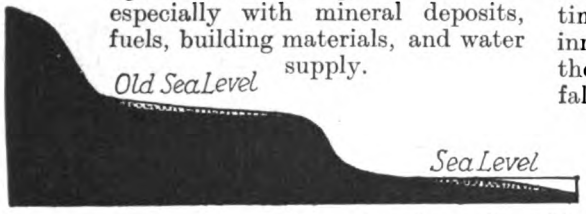


Fig. 1.—In many places we know that the sea has withdrawn from an earlier position, because we find typical sea beaches far above the reach of the waves.

The Key to the Past.—The fundamental doctrine of geology was enunciated by Hutton in 1785 in his famous *Theory of the Earth*. In that work the principle was defined which lies at the basis of dynamical geology, and which has proved to be of the utmost value in wresting from the rocks their history. Hutton declared that in the processes of the present lay the key with which to unlock the secrets of the past. The results of living processes now in action are compared with those of the dead past, and, wherever a satisfactory parallel can be made, ancient geographical conditions are revealed to us, and a dead collection of facts becomes a vivid, living history, seen through the kaleidoscope of the present.

For example, in many places we find typical sea beaches and sea shells far above the reach of the waves, sometimes high up on a cliff, sometimes many miles inland; clearly the sea must have formed them, as it does to-day along the shore line, and we therefore know that the sea has withdrawn from an earlier position, or, what amounts to the same thing, that the land has risen above its former level. The opposite kind of movement is implied in other places by the presence of submerged forests—forests which must once have flourished on the land, but which have since been buried under the advancing sea. Lavas, identical with those now poured from the throats of volcanoes, are found in places where the volcanic fires have long died out, and we know that they must have been formed like their prototypes of to-day. Smooth and striated rocks and valley floors, exactly like those carved out by the grinding action of modern glaciers, show that much of our country was at some time in the past under glacial conditions. The clay through which the tube railways of London are bored contains relics of tropical vegetation, and shells like those of the warm southern seas, and therefore implies a tropical climate at the time when it was formed. Built up from innumerable fragments of evidence such as these, historical geology records the rise and fall of land forms, the invasion and retreat of the sea, the birth and death of volcanoes, the swing of climate from tropical to glacial, and through all the changes of scene so impressively disclosed it traces the gradually unfolding development of life.

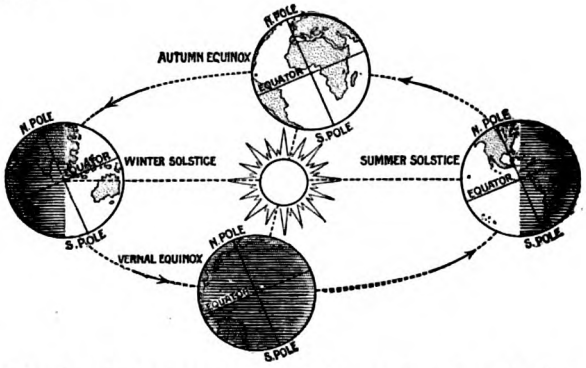


Fig. 2.—To the revolution of the earth and the inclination of its axis are due the succession and temperature variations of the seasons.

The Earth as a Planet.—The earth is one of the minor planets of the sun, around which it revolves in 365¼ days. Its average distance from the sun is nearly 93 million miles, being somewhat less in winter and somewhat more in summer. The plane in which the orbit of the earth lies is called the *ecliptic*, and to this the earth's axis is inclined at 23½°. It is a fact of daily experience that the earth rotates about that axis once every twenty-four hours (*see* Fig. 1, Vol. I., p. 104).

It is to these movements, and to the constant outpouring of solar heat, that many of the surface manifestations of geological processes are traceable. The rotation of the

earth is responsible for the alternation of night and day, with a corresponding fall and rise of temperature. Similarly, to the revolution of the earth and the inclination of its axis are due the succession and temperature variations of the seasons (Fig. 2). Further, owing to the nearly spherical form of the earth, different portions of its surface receive the sun's rays at very different angles. Near the equator, where at midday the sun's rays strike vertically downwards, less heat is absorbed by the atmosphere than near the polar regions, where the rays pass in a more horizontal direction, and are therefore obliged to penetrate a far greater thickness of air. For this reason the equatorial regions are hot and the polar regions cold. The temperature changes set up in the three ways outlined above are primarily responsible for atmospheric winds and ocean currents, the freezing, thawing, and evaporation of moisture, its precipitation as rain or snow, and its return to the ocean in rivers or glaciers. The importance of these phenomena in geological processes will be realised in the following lessons.

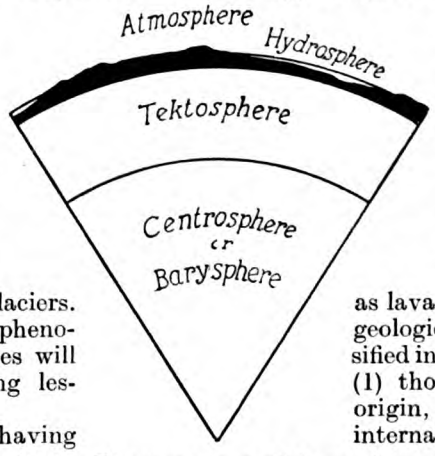


Fig. 3.—The outer parts of the earth are divisible into three zones: the Atmosphere, the Hydrosphere, and the Lithosphere (black), below which are the Tektosphere and the Centrosphere.

The earth is peculiar in having one large satellite, the moon, which revolves about the earth once in every twenty-eight days at a distance from it of nearly 250,000 miles. To the gravitational attraction of the moon and, to a less extent, that of the sun, the *tides* are due (*see* Fig. 24, Vol. I., p. 426).

The earth itself is not quite spherical, but approximates to an oblate spheroid. The polar and equatorial diameters are respectively 7,899 and 7,926 miles, giving a polar flattening of 27 miles. The earth, however, is not strictly even an oblate spheroid, for the equator is an ellipse rather than a circle, and the distribution of land and sea further interferes with the ideal shape. It is, perhaps, best described as pear-shaped rather than orange-shaped, for the south polar continent, corresponding to the stalk end of the pear, projects more than the north polar region, which is occupied by an ocean.

Owing to this irregularity of shape the revolution and rotation of the earth set up internal stresses, which are further complicated by the gravitational attractions of the moon and sun, for the tidal forces are not restricted to the oceans, but are felt throughout the body of the earth. Moreover, the earth itself has an internal heritage of stresses, depending on its origin (whatever that origin may have been), on its constitution and architecture, and on its subsequent history. All such stresses are gradually accumulated until they exceed the resisting forces of the rocks, and are relieved by earth movements. Earthquakes provide the most familiar instance of movements which are sudden and violent. Besides internal activities of a dynamic kind, there are also geological processes in which heat energy plays the controlling part. As we shall see, the earth is charged not only with mechanical energy, but also with thermal energy. We have therefore to consider not only the movements of solid rock masses, but also the movements and expulsion of molten rock, which in volcanoes rises to the earth's surface as lava. It will now be clear that geological processes may be classified into two fundamental groups, (1) those which are of external origin, and (2) those which are of internal origin.

Structure of the Earth.—The earth, as it presents itself to our everyday experience, is naturally divisible into three concentric zones—(1) the atmosphere, (2) the hydrosphere, and (3) the lithosphere.

The atmosphere is the layer of gases constituting the mixture known as air which surrounds the earth. Nearly 99 per cent. consists of oxygen and nitrogen, the remaining gases and vapours which are commingled with them including argon, water vapour, and carbon dioxide, with traces of hydrogen, ammonia, and nitric acid, and of other more unusual gases which are expelled from volcanic vents and liberated from decomposing organic matter. The amount of water vapour varies greatly according to temperature and pressure, and is in a constant state of circulation. It rises from the hydrosphere by evaporation, forms clouds, rain, and snow, and feeds the streams and rivers.

The atmosphere is constantly in a state of motion, familiar as *wind*, due to the rising of warm and the falling of cool air.

PITCHSTONE : from Corriegills, Arran.

GRAMOPHYRE, showing outergrowth of quartz (light) and felspar (dark) ; from Mull.

QUARTZ PORPHYRY : from Dugton Pike, Westmorland.

HORNBLENDE PORPHYRITE ; from Inchnadamff, Sutherland.

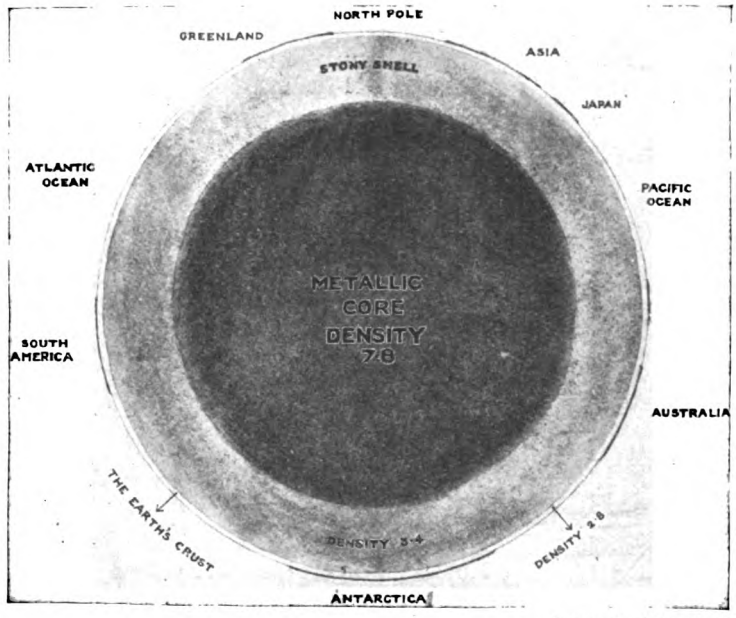
OLIVINE DOLERITE (ophitic) : from Allival Ruin.

HORNBLENDE PURITE : from Lugar, Ayrshire.

PHOTOMICROGRAPHS OF IGNEOUS ROCKS

as viewed in thin sections under a microscope (*cf.* p. 199).

The hydrosphere. All the water on the surface of the globe and that held in the rocks of the outer layers of the lithosphere is included together as the hydrosphere. If it were uniformly distributed around the earth's surface it would form a continuous ocean about two miles in depth. Owing to the distribution of land forms, much of the water is gathered into a series of great oceanic basins which cover nearly three-quarters of the earth's surface. The remaining part exists as a network of rivers and lakes on the land itself and as underground water held in the pores and fissures of the rocks.



Drawn by John Gauld.

SECTION THROUGH THE EARTH'S HEART.

Beneath the rocky crust of the earth, 35 miles in thickness, there is a broad belt of heavier material to a depth of 900 miles. Within this spherical shell of stone lies the great metallic core.

The lithosphere is the rocky crust of the earth, and includes as much of the solid earth as is available for direct study by the geologist. Its surface is very irregular owing to the alternation of continental heights and ocean depths. The oceanic depressions of the surface are very much greater than the continental platforms, as is shown by the following table, in which the percentages of the earth's solid surface between certain levels are tabulated :—

Land areas—		
More than 6,000 ft. above sea level	2·3	27·8
Between sea level and 6,000 ft. above	25·5	
Sea and ocean floor—		
Between sea level and 6,000 ft. below	14·8	72·2
Between 6,000 and 12,000 ft. below sea level	14·8	
Between 12,000 and 18,000 ft. below sea level	39·4	
Between 18,000 and 24,000 ft. below sea level	3·1	
More than 24,000 ft. below sea level	0·1	
	100·0	100·0

At present the oceans must be regarded as to some extent overflowing the true continental platforms, for surrounding the visible land surfaces there is generally a submerged border extending outwards with a gentle slope to an average depth of about 100 fathoms, after which the sea floor rapidly descends to oceanic depths. The submerged border is known as a continental shelf, and the shallow seas which lie upon it, such as the North Sea and the Baltic, are called epicontinental seas.

The lithosphere itself is built up of innumerable varieties of rocks, the study of which constitutes the chief object of geology. Direct observations are not possible at depths from the existing surface of much more than a mile, this being the present limit of borings and mines.

We shall not be limited by this, for as we shall see later on, we may perhaps consider ourselves indirectly familiar with rocks and processes characteristic of depths far greater than this, and the outer ten or twenty miles may be conveniently referred to as the earth's *crust*.

The average specific gravity of known rocks is about 2·8, that of the crust as a whole being perhaps a little more than this, owing to the greater heaviness of the more deep-seated rocks. The average composition of rocks has already been given in the Mineralogy Course (*see* Vol. IV., pp. 269, 270).

The average specific gravity of the whole

earth is 5·6, and it is therefore certain that the great interior of the earth, about which we have little definite knowledge, is made up of considerably heavier materials than those of the crust.

One may indeed say that every conceivable hypothesis has at one time or another been held as to the nature of the earth's interior, and every state of matter—solid, liquid, and gaseous—has been ascribed to it.

In considering this question, it must, of course, be remembered that under the immensely high pressures of the interior these terms have but little significance, and what is more important for us is to know whether it is essentially rigid and elastic or viscous and non-elastic.

The former condition, that is, rigid and elastic, probably represents the truth, and in so far as the word applies to our ordinary experience, the interior of the earth may be described as *solid*.

It is further believed that this central mass is divided into a number of zones, becoming heavier with depth—(1) a stony zone with a specific gravity of about 3·4; (2) a series of intermediate zones formed of stony and metallic materials; and (3) a central core of metal which is probably iron and iron-nickel alloy, having a specific gravity of nearly 8.

The diagram on page 142 will make clear to the student the relative magnitudes of the various zones; the lithosphere—the black uneven strip in the figure—is comparatively small.

The stony zone has been called the *tektosphere* by the late Sir John Murray, for it appears to be a zone in which the rocks, being comparatively plastic under conditions of high pressure lasting for long periods, are able to adjust themselves by flowage, and so to balance the effects of the superficial forces of the lithosphere and the deep-seated forces of the centrosphere below, and thus to maintain the earth in a state of equilibrium.

It acts, so to speak, as a buffer, preventing, on the one hand, the undue accumulation of stresses which would ultimately bring about great catastrophes; and, on the other hand, the stagnation which would be brought about if the superficial forces were left to themselves—two very necessary functions.

The student will observe that below the tektosphere is the heavy metallic core which, from its position, has been called the *centrosphere*, and, from its greater weight, the *barysphere*. A. H.

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ZOOLOGY.—XXVIII

THE semi-transparent body of the Jelly Fish has perplexed more than one curious tripper upon the seashore. For while there are many forms of marine life which Ignorance will readily dismiss as vegetable products, this creature has a baffling appearance utterly unlike any other form of life with which the casual observer is familiar. A close examination, however, will soon disclose the animal characteristics of this floating disc, for on the under surface appears a central opening into which the finger can pass. This tell-tale cavity is the mouth from which there runs a passage to the stomach which can be roughly defined by the four coloured and circular spots visible on the top of the body.

Jelly Fish and Sea Anemones

Some of the jelly fish such as the *Cyanea arctica* attain to a great size. Yet, it is stated, a specimen weighing 34 lb. on being left to dry in the sun for some days lost ninety-nine-hundredths of its original weight. A jelly fish of this weight would measure seven feet in diameter without its tentacles and, apparently, would be principally composed of water. The prey of the Common Blue Jelly Fish consists chiefly of small crustacea and other marine creatures.

The celebrated Portuguese Man-of-War is a member of the order *Siphonophora* and a native of all tropical seas. The general shape of this creature is a bubble-like envelope, pointed at one end and rounded at the other, from it a number of tentacles are suspended. The Man-of-War assumes many beautiful tints which may be considered as compensation for the formidable stinging processes with which the tentacles are armed.

The appearance of the Sea Anemone is readily recognisable by everyone. The most common on the British coast is the Common Red Sea Anemone which may usually be found between the tide marks. Sea Anemones commence life as free swimming larvæ, but after a very brief time settle upon the floor of the sea. Most are sedentary though some undertake short journeys from one resting place to another. Despite their appearance of innocence they are voracious feeders, killing and paralysing their prey by means of their thread cells.

The White Stony Corals bear some resemblance in outward form to the Anemone which they resemble also in the free life of

the larva. When bedded the Coral lives upon minute organisms floating in the water. As these are digested the bulk of the coral increases. The Reef Building Corals form vast colonies of which all the members bud from the parent.

Mr. Martin Duncan has thus described the process: "First a little projection appears on the side of the parent cup and soon a few tentacles are formed, until by its outward growth the little bud resembles the parent. Other buds now arise and all grow upwards in a bush-like form, fresh successions of buds constantly being produced. As the growth progresses, either the bush shape remains or else structures composed of layers of hard tissue arranged in cellular compartments or cross-bars, so as to give both lightness and strength, are grown between the buds and parent, connecting the whole into a solid mass, or 'exotheca.'"

This budding process indefinitely continued by countless animals over unnumbered years forms in the course of time solid masses which ultimately appear upon the surface of the water in the guise of coral reefs. The finest tribute ever paid to the small organisms responsible for these great achievements was probably that of Charles Darwin. Writing of a visit to Keeling Island and the coral formation in the vicinity, he says:

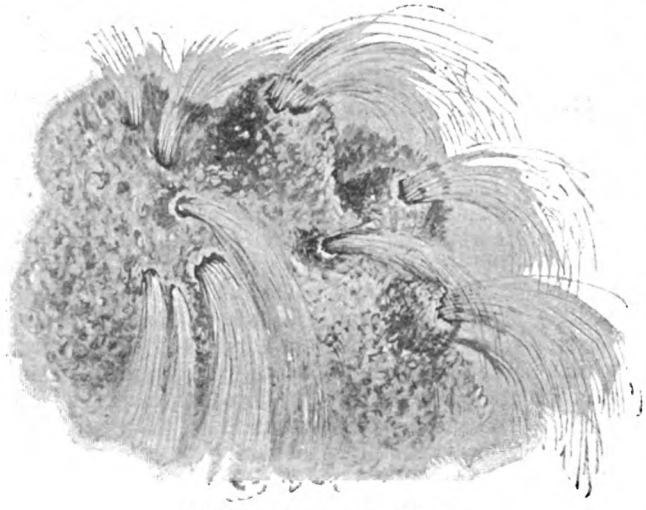
"Such formations surely rank high amongst the wonderful objects of the world. Captain Fitz Ray found no bottom with a line 7,200 feet in length, at the distance of only 2,200 yards from the shore; hence this island forms a lofty submarine mountain, with sides steeper even than those of the most volcanic cone. The saucer-like summit is nearly ten miles across; and

DIAGRAMMATIC SECTION OF A PIECE OF SPONGE.

The arrows indicate the direction of currents, showing how water enters by the small pores and passes out by the large oscules. The water which enters brings food to the cells which line the channels.

every single atom from the least particle to the largest fragment of rock which, in this great pile, however, is small compared with very many other lagoon islands, bears the stamp of having been subjected to organic arrangement. We feel surprised when travellers tell us of the vast dimensions of the Pyramids and other great ruins, but how utterly insignificant are the greatest of these, when compared to these mountains of stone accumulated by the agency of various minute and tender animals! This is a wonder which does not at first strike the eye of the body, but, after reflection, the eye of reason."

Reef-building Corals do not live at a greater depth than from twenty to thirty fathoms from the surface, and this fact at first sight appears to present many difficulties when the origin of very deep coral reefs is in question. Darwin's



THE SPONGE AT WORK.

Currents of water passing from the oscules, as seen under the microscope.

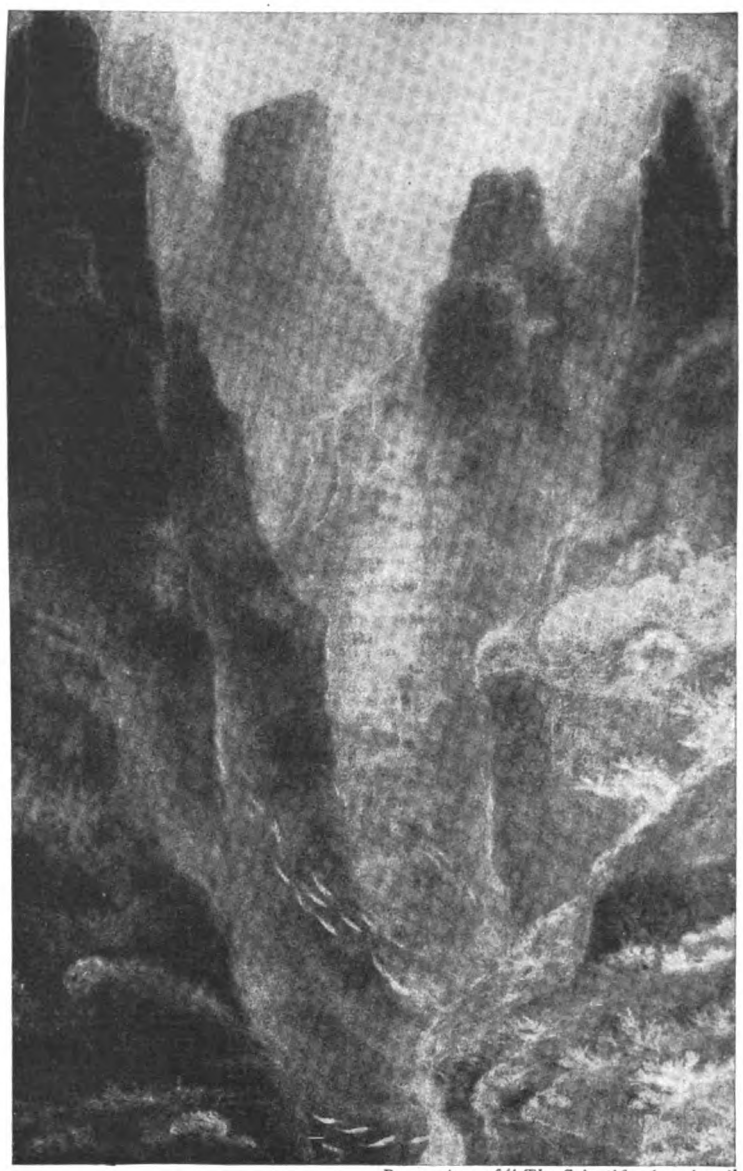
theory, however, finds a solution to all difficulties in the gradual subsidence of the land. As the cone-shaped mountain subsided so the coral reef originally close to its shore would tend to stand farther out to sea. Eventually the very pinnacles of the land disappears, and all that remains to mark its site is the circular barrier which the Corals have ceaselessly laboured to maintain at the surface of the ocean.

Sponges and Protozoa

The Sponges form a compact but widely distributed group of what are known as multicellular animals. In life many species are beautifully coloured and all present an appearance very different from that of the lifeless but useful appendage to the bathroom. So slight is the indication afforded by the actual appearance of this animal to its manner of life that until comparatively recent times naturalists were at a loss to know whether it was an animal or a plant.

The first clue to the truth was provided by the dilation and contraction of the oscular openings, from which it was discovered that sponges suck in and squirt out water. It was next noticed that currents of water containing floating particles of food flowed inwards, and that the currents bearing fæcal residues flowed outwards. Finally the motive power responsible for the streaming currents was traced to minute cilia or whip-like filaments which are arranged in what are known as flagellated chambers. The beating of the whip sets up currents which bring in food particles and oxygenated sea water, the used-up water and debris being driven through the oscules.

At certain seasons the body develops egg-cells, from which proceed small oval embryos. These embryos are for a brief while free swimmers, then settling they assume the sponge form and depend for their food upon the currents set up by the ciliated cells. The character of the skeleton is exceedingly diverse, but since



By courtesy of "The Scientific American."

CORAL FORMATIONS IN THE SOUTH SEAS.

Reproduced from a striking sketch which was made actually under water and which illustrates how the movements of innumerable lithophytes of bygone ages have by slow degrees grown tall enough to raise their summits above the water.

it is usually constant in each species it is generally adopted as a basis for classification.

The yellow or greenish crust of the Crumb-of-Bread Sponge may be seen on innumerable rocks round the British coast; this sponge may also be detected in a shapeless mass round the stems of seaweeds.

Under the title *Protozoa* are grouped the simplest animals, the most elementary forms in which animal life is said to be found.

In most instances, as we should expect to be the case, the animals of this group are exceedingly small. Frequently they are so minute as to be invisible without the assistance of the microscope. Other animals are composed of a large number of cells of different kinds which divide between them the labour of the body, but in the *Protozoa* the body consists of but one "cell" which undertakes the very limited number of functions required of life in so simple a form.

Amœba

Some *Protozoa* form colonies, but the "cells" in such cases remain entirely independent of each other. The jelly-like substance of these creatures takes to itself no distinguishing form.

The *Amœba Proteus*, or, as it is also called, the *Proteus Animalcule*, which is seen under the microscope to be a small spot of whitish jelly, progresses by thrusting out new projections from its surface whilst pre-existing projections melt away. It is not possible to speak of the stomach of such an organism, yet it devours suitable substances of infinitesimal dimensions. It may be said to "envelop" them rather than to devour them.

As a consequence of a sufficiency of food the *Amœba* increases in size until there takes place that strange miracle of Nature which effects an increase in the race at the expense of simple division in the individual. For the *Amœba* divides into two parts each of which henceforward is a distinct entity. The size of the Amœba is only about the one-hundredth part of an inch.

An important division of the *Protozoa*, known as the *Infusoria*, is concerned with the tiny specks which may be seen swimming about in a vessel of water which has contained some animal or vegetable substance, and which is exposed to the air. Examined beneath a high-powered microscope, sea water or pond water will disclose hosts of creatures of all shapes and sizes. These creatures known as the *Infusoria*, active, wandering or sedentary, constitute the lowest forms in the animal kingdom. In some instances they are so small that only a high-powered microscope, magnifying from 300 to 1,000 times, will suffice to reveal their presence.

Fresh rain water, however, will not show any of these forms of life since it lacks the organic matter which serves as nutriment to the germs. In short, the germs though present cannot develop for lack of food.

With the advent of vegetable matter, however, their development is rapid, but it is noticeable that the *Animalculæ* invariably bear some relationship to the particular substance supplied. The body of the *Infusoria* is "usually soft, and there are one or more contractile vesicles. A nucleus exists, and there are vacuoles which contain food."

"The outside of the *Infusoria's* body is ciliated in a great number, but has one or two long cilia in front in others, and one group has no cilia, but tabular processes project from the more or less pear-shaped body, and really act as suckers."

Mighty Atoms

What has been said will serve to indicate the type of creature which is included in this extraordinary sub-kingdom of simply-formed animals.

An attempt to define, in a manner intelligible to the reader who has not previously studied the subject, the various classes of Animalculæ which science has discovered would be impossible of success within the limited space at our disposal. And indeed, except from the point of view of the specialist, this branch of life makes in fact but scant appeal.

Yet, the importance of this vast domain, still largely unmapped and even unexplored, becomes every year more and more apparent, for science is constantly discovering in these infinitesimal creatures the prime agents of disease and death.

One may well say that of the many strange and astonishing decrees of Nature, surely there is none more strange or astonishing than this, that for many thousands of years the destiny of the highest of all the animals has been swayed and often determined by creatures so utterly insignificant that without the assistance of the microscope it is scarcely within the power of man to see them.

A. B.

Continued from page 98.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A. [Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

GERMAN.—XXIX

Adverbs (*Continued*).—A certain number of adverbs which now appear to be simple words are really combinations. Such are zwar, *indeed, in truth*, ſonſt, *otherwise*, nimmer, *never more*, heute, *to-day*, and so on.

Lastly, we have a great many adverbs which in part at least are formed from pronouns and other words, but whose derivation does not lie within the scope of this course. Such are :

1. Adverbs of place and direction : auf, *up*, ab, *off*, an, *on, at*, aus, *out*, bei, *by*, durch, *through*, ein and in, *in*, um, *round*, vor, *in front*, zu, *at, to*.

2. Adverbs formed from the demonstrative pronominal root which appears in der: da, dar, *there*, dann, denn, *then*, dort, *there*, doch, *though, yet*, deſto, *the* (in expressions like the more the merrier).

3. Adverbs formed from the interrogative pronominal root which appears in wer: wie, *how*, wo, *where*, wenn, wann, *when*.

4. Adverbs which are formed from a pronominal root which appears in the English demonstrative use of *he :* hie, hier, *here*, her, *hither*, hin, *thither*, hinter, *behind*.

5. Adverbs, derived from the above : innen, *inside*, außen, *outside*, dannen, *thence*, ober, *upper*, oben, *above* (from ob), and so on.

Comparison of Adverbs.—Most adverbs do not admit of comparison, but the comparative and superlative forms of most adjectives can be used adverbially.

The adverb oft forms a comparative öfter and a superlative am öfteſten ; bald, *soon*, has a comparative and a superlative formed from the conjunction ehe, *before*, thus, eher, am eheſten, but the superlative baldigſt, *as soon as possible*, is also used ; the adverb gern has the forms lieber, am liebſten.

Some adverbs can modify prepositional phrases which themselves have the value of adverbs. Thus, rings um die Stadt, *round about the town.*

Some adverbs can be used after prepositions. Thus, nach unten, *downwards*, i.e. towards down, bis jetzt, *up till now*, and so on.

Some adverbs are sometimes used almost with the force of adjectives. Thus, dieſe Frau hier, *this woman here*, das Buch dort, *the book over there.*

Just as in English, adverbs can be used as complements to complete the meaning of the verb *to be.* Thus, die guten Zeiten ſind vorbei, *the good times are over.*

The adverb erſt in addition to its proper meaning of *first*, often denotes *not before, only.* Thus, er kommt erſt morgen, *he will not come before to-morrow ;* erſt als ich mit ihm ſprach erkannte ich ihn, *it was only when I spoke to him that I recognised him.*

It is also used to emphasise such words as noch, doch, and so on. Das muß ſich erſt noch zeigen, *that still remains to be seen.* Wären doch die böſen Zeiten erſt vorüber! *if only the bad times were over!*

Noch denotes *yet, still*, with regard to time. Thus, ſie iſt noch hier, *she is still here.*

Noch nicht, means *not yet*, and noch einmal means *once again.* Noch, followed by a noun preceded by the indefinite article, means *another.* Thus, noch ein Stück Brot, *another piece of bread.*

Auch, *also, too*, when it occurs in a clause beginning with one of the relatives wer, wie, was, wo, wann has a generalising meaning. It takes a verb in the conjunctive mood, and corresponds to the English suffix *ever*, wer auch kommen möge, *whoever may come.*

There is a distinction between the adverbs damals and dann, both meaning *then.* Damals always refers to a definite time in the past, dann has a more general sense, and may refer to any time present, past, or future. Thus, er war damals noch ein Kind, *he was then* (at that time) *a child still ;* erſt haben wir geſpeiſt und dann wurde getanzt, *first we had a meal and then there was dancing ;* Wie ſpät iſt es ? Es iſt gleich halb zwölf. Dann kann ich nicht länger bleiben, *how late is it ?*

It is almost half past eleven. Then I cannot stay any longer.

For *then* in the sense of *consequently, accordingly*, denn is often used.

The interrogative *when?* is always rendered by wann in German.

Adverbs which modify adjectives, or adverbs, or adverbial phrases, always precede the words they modify, with the exception of genug, *enough*, which comes after, as it does in English.

Adverbs which modify finite parts of a verb are, as a rule, placed after the verb; those which modify participles and infinitives are placed before.

VOCABULARY

betroffen, *in consternation.*
kaum, *scarcely.*
zanken, w., *to quarrel.*
umſonſt, *in vain.*
Pauſe, w.f., *pause.*
faſt, *almost.*
Glaube, w.m., *faith.*
entſchuldigen, w., *to excuse.*
Abſicht, w.f., *purpose.*
nennen, w., *to name.*
Kleidung, w.f., *clothing.*
Trank, s.m.2, *drink.*
Grund, s.m.2, *basis, fundamentals, principles.*
ſchreiben, s., *to write.*
Treue, w.f., *trust.*
annehmen, s., *to accept.*
Zweifel, s.m.1, *doubt.*
Blut, s.n., *blood.*
Probe, w.f., *sample, proof.*
heilſam, *salutary, beneficial.*
verlangen, w., *to demand.*
Lüge, w.f., *lie.*
Lügen ſtrafen, *to accuse of lying.*
nämlich, *the same.*
lebendig, *living.*
verſtummen, w., *to grow dumb.*
gelten, s., *to hold good, be valid.*
Chriſt, w.m., *Christian.*
ſich wenden, w., *to turn.*
unterſu'chen, w., *to examine.*
klagen, w., *to complain, go to law.*
erweislich, *demonstrable.*
erwarten, w., *to await.*
recht, *right, true.*
bloß, *only.*
ſich getrauen, w., *to trust oneself.*
Religion, w.f., *religion.*
bis auf, *even to.*
Speiſe, w.f., *food.*
Seite, w.f., *side.*
ſich gründen, w., *to be founded.*
Geſchichte, w.f., *history.*
überlie'fern, w., *to hand down by tradition.*
ziehen, s., *to draw.*
in Zweifel ziehen, *to cast doubt upon.*
Kindheit, w.f., *childhood.*
täuſchen, w., *to deceive.*
glauben, w., gov. dat., *to believe.*
umgekehrt, *conversely.*
Vorfahr, w.m., *ancestor.*
ſtrafen, w., *to punish.*
widerſpre'chen, s., *to contradict*, gov. dat.
Recht haben, *to be right.*

Exercise 65 (*Continued from* Exercise 63)

Saladin—

(der ſich betroffen von ihm gewandt[1])

Ich hör', ich höre. — Komm mit deinem Märchen
Nur bald zu Ende[2]. — Wird's[3]?

Nathan.—

Ich bin zu Ende.
Denn was noch folgt, verſteht[4] ſich ja von ſelbſt. —
Kaum war der Vater todt, ſo[5] kommt ein jeder
Mit ſeinem Ring, und jeder will der Fürſt
Des Hauſes ſeyn. Mann unterſucht, man zankt,
Man klagt. — Umſonſt; der rechte Ring war nicht
Erweislich; —

(Nach einer Pauſe, in welcher er des Sultans Antwort erwartet)

Faſt ſo unerweislich, als
Uns jetzt — der rechte Glaube[6].

Saladin.—

Wie? das ſoll
Die Antwort ſeyn auf meine Frage? . . .

Nathan.—

Soll[7]
Mich bloß entſchuldigen, wenn ich die Ringe[8]
Mir nicht getrau' zu unterſcheiden, die
Der Vater in der Abſicht machen ließ,
Damit[9] ſie nicht zu unterſcheiden[10] wären[11].

Saladin.—

Die Ringe. — Spiele nicht mit mir. — Ich dächte[12]
Daß die Religionen, die ich dir
Genannt, doch wohl[13] zu unterſcheiden[10] wären.
Bis auf die Kleidung; bis auf Speis' und Trank.

Nathan.—

Und nur von Seiten[14] ihrer Gründe nicht. —
Denn gründen alle ſich nicht auf Geſchichte?
Geſchrieben oder überliefert. — Und
Geſchichte muß doch wohl allein auf Treu'[15]
Und Glauben angenommen werden? — Nicht?[16] —
Nun weſſen Treu' und Glauben zieht man denn
Am wenigſten in Zweifel? Doch der Seinen?[17]
Doch[18] deren Blut wir ſind? doch deren, die
Von Kindheit an uns Proben ihrer Liebe
Gegeben?[19] die uns nie getäuſcht[19] als[20] wo
Getäuſcht zu werden uns heilſamer war? —
Wie kann ich meinen Vätern weniger,
Als du den deinen glauben? Oder umgekehrt:
Kann ich von dir verlangen, daß du deine
Vorfahren Lügen ſtrafſt, um meinen nicht
Zu widerſprechen? Oder umgekehrt.
Das Nämliche gilt von den Chriſten. Nicht? —

Saladin.—

Bei dem Lebendigen.[21] Der Mann hat Recht,
Ich muß verſtummen.

NOTES:—

(1) gewandt, the auxiliary hat must be supplied with this. When the perfect tense is used it is quite common to omit the auxiliary haben and simply use the past participle of the verb. (2) zu Ende kommen, *to make an end, to finish.* (3) wird's? or wird's bald? is used elliptically, meaning, will it soon take place? i.e. hurry, be quick. (4) ſich von ſelbſt verſtehen, *to be self-understood.* (5) ſo, *when.* (6) Glaube, the verb iſt is understood after this. (7) ſoll, this takes up the ſoll used by the Sultan in his question, and has the same subject, namely das. (8) Ringe, in the normal order die Ringe would follow getraue. (9) damit, one would expect daß instead of damit; the clause introduced by damit is in apposition to Abſicht which it explains. (10) unterſcheiden, active infinitive in a passive sense. (11) wären, conjunctive of purpose. (12) dächte, the conjunctive used to express an opinion without the positiveness of an assertion. (13) doch wohl, *surely.* (14) von Seiten, *from the point of view of, with respect to.* (15) auf Treu' und Glauben, *upon trust.* Treu' und Glauben correspond to our expression good faith. (16) Nicht? this interrogative use of nicht after making a statement is very common in German. It means, is that not so? (17) der Seinen, the genitive of the possessive adjective used as a noun, i.e. of one's own people. The

genitive depends on Treu' und Glauben understood. (18) doch . . . sind. One deren is understood. The full sentence would be doch deren (Treu' und Glauben) deren Blut wir sind, *surely* (the good faith) *of those of whose blood we are*. The demonstrative deren is omitted, and the relative deren is retained. In the next sentence the deren used is the demonstrative pronoun. (19) gegeben, getäuscht, *see* (1). (20) als, *except*. (21) Lebendigen, with this adjective used as a noun the noun God must be understood.

VOCABULARY

sweet pretty, reizend schön.
take (a walk), einen Spaziergang machen, w.
gloom, sich verdunkle, w.
shade, Schatten, w.m.
wall, Mauer, w.f.
call (of cattle), blöken, w.
chatterbox, Schwatzbase, w.f.
babble, plappern, w.
several times, mehrmals.
overtake, treffen, s.
hobbledehoy, langgliedriger Bursche, w.m.
trousers, Hosen, w., pl.
dawdle from out, hinausschlenkern aus.
up to, vor.
charm, bezaubern, w.
blind to, blind gegen.
lesson, Lektion, w.f.
supper, Abendessen, s.n.1.
scolding, Strafpredigt, w.f.
absorbed, vertieft.
utterly and entirely, ganz und gar.
walk, Spaziergang, s.m.2.
mark, beobachten, w.
mountain, Berg, s.m.2.
purple, Purpur, s.m.
creep up, hinaufschleichen, s. sep.
brawl (of a river), rauschen, w.
cattle, Kühe, pl. of Kuh, s.f.2.
fountain, Springbrunnen, w. s.m.1,
bawl, kreischen, w.
course, Lauf, s.m.
lazy, träge, faul.
slouching, schwerfällig.
rusty, abgetragen.
coat, Rock, s.m.2.
trail, sich schleppen, w.
tight, eng.
sleeve, Ärmel, s.m.1.
I daresay, wahrscheinlich.
ravish, entzücken, w.
unmindful, uneingedenk, gov. gen.
forgetful of, vergessend.
prepare, vorbereiten, w. sep.

Exercise 66

There[1] was a sweet pretty river[2] walk we[3] used to take in the evening and mark the mountains round glooming[4] with a deeper purple; the shades[5] creeping up the golden walls; the river brawling, the cattle calling, the maids and chatterboxes round the fountains babbling and bawling; and several times we overtook a lazy slouching boy, or[6] hobbledehoy, with a rusty coat, and trousers not too long, and big feet trailing lazily one after the other, and large lazy hands dawdling from out the tight sleeves, and in the lazy hands a little book, which my[7] lad held up to his face, and which I daresay so charmed and ravished him, that he was blind to the beautiful sights[8] around him; unmindful, I would venture to lay any wager,[9] of the lessons he had to learn for to-morrow; forgetful of mother waiting[10] supper, and father preparing a scolding;—absorbed utterly and entirely in his book. *W. M. Thackeray.*

NOTES:—

(1) er war dort. (2) *River*, say dem Fluß entlang (along the river). (3) *We . . .* the relative must not be omitted before this in German. (4) *Glooming*, say *which gloomed to a deeper purple*. All the following present participles should be turned in German into adjectival clauses introduced by relative pronouns. (5) Note that *shades*, *river*, etc., are all governed by *mark*, and must therefore be in the accusative. Similarly coat, trousers, feet, hands are all dative, governed by mit (with). (6) Omit *or*, and use the indefinite article. (7) *My*, say *the*. (8) *Beautiful sights*, Schönheit (beauty). (9) *I . . . wager*, turn this thus: I would wager (wetten, w.) that he was unmindful. (10) *Waiting, preparing—see* (5). Say, *waiting with the supper*.

Key to Exercise 63

Long (grey) years ago there lived a man in the East who possessed a ring of priceless worth given him by a loving hand. The stone was an opal, which glittered with a hundred lovely colours, and had the secret power of making him find favour in the eyes of God and man, who wore it and trusted its power (making him pleasing before God and man, who wore it with this trust). What wonder that the man in the East, therefore, never let it leave his finger, and arranged so as to keep it evermore in his family (house)? Namely thus. He left the ring to the best beloved of his sons, and decreed that he in his turn should leave it to that one of his sons who was dearest to him; and always the best beloved, irrespective of birth, by virtue of the ring alone, was to be the head, the prince of the house. —Understand me, Sultan?

Saladin.—I understand you. Go on.

Nathan.—In this way now the ring came down from son to son to the father of three sons, who were all equally dutiful to him, and whom he consequently could not forbear to love equally. Only from time to time—as each happened to be alone with him, and the other two did not share in his overflowing heart—first this one, then that one, and then the third one seemed to him to be more worthy of the ring, which he had the innocent weakness to promise to each one. That was very well as long as it lasted. But the time came for him to die, and the good father is in a difficulty. It pains him thus to grieve two of his sons who rely on his word. What is to be done? He sends secretly for an artist, from whom he orders two other rings after the pattern of his own, and orders neither expense nor trouble to be spared in making them like, exactly like, his own (that one). The artist succeeds. When he brings him the rings the father himself cannot distinguish his pattern ring. Glad and happy he calls his sons, each separately; gives to each separately his blessing—and his ring—and dies.—Are you listening, Sultan?

Key to Exercise 64

Dieser Umstand veranlaßte Grotius Frau einen Plan zu seiner Befreiung auszudenken; und sie überredete ihn eines Tages sich anstatt der Bücher, die hinausgetragen werden sollten, in die Kiste zu legen. Als die zwei Soldaten, deren Pflicht es war dieselbe hinauszutragen, sie aufhoben, fanden sie, daß sie bedeutend schwerer als gewöhnlich war, und einer von ihnen fragte im Scherz, „Sollten wir den Arminius selbst hier in der Kiste haben?" worauf die Frau mit Geistesgegenwart antwortete, „Ja, wahrscheinlich einige arminische Bücher." Die Kiste kam unversehrt in Gorcum an; der Gefangene wurde befreit; Grotius entwischte über die Grenze nach Brabant, und später nach Frankreich wo seine Frau sich ihm anschloß.

M. A. L.

RUSSIAN.—XX

VOCABULARY

Газе́та, *newspaper.*
Намъ тре́буется, *we require.*
По, *on.*
Наде́жда, *the hope.*
Привле́чь (P.), *to attract.*
Со зна́ніемъ, *with knowledge.*
Ще́дро, *liberally.*
За оказанныя услу́ги, *for services rendered.*
Да́бы, *in order that.*
Слу́жащій (or служа́щій), *employee.*
Стара́ться (Imp.), *to try.*
Охо́та, *liking.*
Продолжа́ть (Imp)., *to continue.*
У, *at, with.*
Приня́ться (P.), *to take to.*
Собира́ніе, *gathering.*
Аккредити́въ, *letter of credit.*
Дана́ была́, *was given.*
Возможность, *the chance, possibility.*
Достиже́ніе, *attaining, obtaining.*
Лёгкій до́ступъ, *easy access.*
По разсчёту, *likely, as estimated.*
Станови́ться (Imp.), *to become.*
Пополне́ніе, *the filling, supplying.*
Нужда́, *a want, need.*
Заграни́цей, *abroad.*
Посѣща́ть (Imp.), *to visit.*
Безпосре́дственный, *direct.*
Къ тому́ вре́мени, *towards that time.*
Заключи́ть (P.), *to conclude, make.*
Главнѣ́йшій сортъ, *principal sort.*
Подо́бный, *such, similar.*
Образъ дѣйствія, *manner of action.*
Законтрактова́ть (P.), *to forestall, contract.*
Допусти́ть (P.), *to admit.*
Соуча́ствованіе, *participation.*
Слѣ́дить за чѣмъ (Imp.), *to watch something, see to.*
Обнару́живаться (Imp.), *to transpire, be found, come to light.*
Прія́тіе, *accepting.*
Излишній, *superfluous, unnecessary.*
Разсчи́тывать (Imp.), *to reckon, expect.*
Повы́ситься (P.), *to become dearer.*
Повтори́тельный зака́зъ, *repeat order.*
Благоразу́мный, *prudent.*
Вялъ, *dull, slack, weak, faded.*
Полага́ть (Imp.), *to presume.*
Упа́сть (P.), *to fall.*
Ни́зкій, *low.*
У́ровень (masc.), *a level.*
Угоди́ть (P.), *to please.*
Усло́вленный, *arranged.*
Тща́тельно, *carefully.*
Едва́, *hardly.*
Отдѣ́латься (P.), *to rid oneself.*
Прете́нзія, *a claim.*
Значи́тельно, *considerably.*
Сократи́ть (P.), *to shorten, diminish.*
Несхо́дство, *dissimilarity, discrepancy.*
Отдѣ́лка, *the finish.*
Аппрету́ра, *the finish.*
Ни́тка, *a thread.*
Соразмѣ́рный, *commensurate, adequate.*
Усту́пка, *allowance, reduction.*
Разумѣ́ется, *it is understood, as a matter of course.*
На слу́чай, *in case.*
Е́сли, *if.*
Ошибочный, *faulty, erroneous.*
Мѣ́сто, *place, package, bale.*
Тюкъ, *package, bale.*
Содержа́ть (Imp.), *to contain.*
Доста́вленъ, *delivered.*
Выбра́сывать (Imp.), *to throw out.*
Бракъ, *trash, refuse, "jobs" (defective textiles).*
Такъ какъ, *as, for, because.*
Совершённый, *perfect.*
Фрахтъ, *freight.*
Ки́па, *bale, package.*
Отправи́тель, *carrier, forwarding agent.*
Желѣ́зно доро́жная ста́нція, *railway station.*
Непра́вильность, *irregularity, discrepancy.*
Отказа́ться (P.), *to refuse.*
Съ недоста́тками, *with faults.*
Предъяви́ть (P.), *to make.*
Съ цѣ́лью, *with the object, aim.*
Поро́къ, *fault, defect, blemish.*
Загиб, *lap, fold.*
Впослѣ́дствіи (from Въ послѣ́дствіе, *consequence, result*), *afterwards.*
Отходи́ть (Imp.), *to go off.*
Мѣ́сто назначе́нія, *place of destination.*
Отосла́ть (P.), *to send off, forward.*
Затѣ́мъ, *then.*
Увеличе́ніе, *increasing.*
Сбыть, *sale.*
Экспортёръ, *exporter.*
Ангажи́ровать (Imp.), *to engage.*
Соотвѣ́тствующій, *suitable.*
Че́резъ чуръ мно́го, *too much.*
Недово́льны, *discontent.*
Совершённый (passive past partic.), *accomplished* (N.B., соверше́нный, adj., *complete*).
Бла́годаря́ чему́, *owing* (thanks) *to which.*
Лиши́ться (P.), *to lose, be deprived.*
Содѣ́йствіе, *co-operation.*
Мину́та, *a minute.*
Спи́сокъ, *list, table.*
То есть, *i.e., it is, that is, namely.*
Сто́имость, *the cost.*
Круговóе, *circular.*
Останáвливаться (Imp.), *to stop.*
На́добность, *need, necessity.*
Вынима́ть (Imp.), *to take out.*
Потре́бный, *required.*
Подвер|га́ть себя́ (Imp.), *to expose oneself.*
Препровожде́ніе, *forwarding.*
Портъ, *port.*
Отсы́лка, *sending off.*
Невозмóжно, *it is impossible.*
Вести́ (Imp.), *to carry on.*
По́льза, *benefit.*
Печа́тать (Imp.), *to print.*
Вы́нужденъ, *compelled.*
Оста́вить (P.), *to leave.*
Распоряже́ніе, *disposal.*
Сиби́рь (fem.), *Siberia.*
я́йцо́, *an egg.*
Ма́сло, *butter.*
Отказа́ться отъ (P.), *to renounce, abstain from.*
Небезпе́чный, *uncertain.*
Сдѣ́лка, *transaction.*
Нали́чными, *in ready cash.*
Пусто́й, *empty.*
Форма́льность (f e m.), *formality.*
Намѣ́реваться (Imp), *to intend.*
Ѣ́хать (Imp.), *to go.*
недѣ́ля, *a week.*
Постоя́нно, *continually.*
Сидѣ́ть (Imp.), *to sit.*
Сре́дства (Neuter, Plur.), *means.*
Энергія, *energy.*
Процвѣта́ть (Imp.), *to flourish.*
Споръ, *a dispute.*
Недоразумѣ́ніе, *misunderstanding.*
Бла́годари́ть (Imp.), *to thank.*
Отпусти́ть (P.), *to let have.*
Предме́тъ, *article.*
Успѣ́ть (P.), *to manage.*
Ко́нчить (P.), *to finish.*
Взя́ться (P.), *to betake oneself.*
Наконе́цъ, *at last.*
Конто́рка, *counter.*
Стопа́, *a ream.*
Пако́вочная б у м а́ г а, *packing paper.*
Стра́нный, *funny.*
Персона́лъ, *staff.*
Заказна́я Кни́га, *order book* (N.B., зака́зный,-ная,-ное, adj., = *forbidden*).

Exercise 32

1. Мы отпра́вили нѣ́сколько спекулятѝвныхъ образцо́въ, а затѣ́мъ объявля́ли о тре́бующихся намъ бо́льше слу́жащихъ (or : служа́щихъ).

2. Принесу́тъ ли э́ти образцы́ зака́зы отъ фирмъ, кото́рыя ихъ полу́чатъ ?

3. Они́ тре́буютъ энерги́чныхъ вояжёровъ для увеличе́нія сбы́та ихъ това́ровъ.

4. Е́сли Вы зна́ете языки́ и тре́бованія ра́зныхъ рынковъ, съ кото́рыми мы подде́рживаемъ сноше́нія, любо́й экспортёръ былъ бы радъ ангажи́ровать Васъ на щёдромъ жа́лованіи.

5. Выбира́йте наибо́лѣе соотвѣ́тствующаго челове́ка и да́йте ему́ хоро́шее жа́лованье, но не че́резъ чуръ мно́го ; и́наче други́е слу́жащіе (or : служа́щіе) бу́дутъ недово́льны.

6. Ихъ принци́помъ до́лженъ быть хорошо́ вознагражда́ть за совершённую рабо́ту, благодаря́ чему́ они́ полу́чать са́мые лу́чшіе результа́ты и не лиша́тся такъ ско́ро содѣ́йствія ихъ слу́жащихъ (or : служа́щихъ).

7. Не теря́йте ни мину́ты, а собери́те колле́кцію образцо́въ для вояжёра и соста́вьте его́ спи́сокъ цѣнъ, то есть, цѣнъ сто́имости и прода́жи.

8. Не забу́дьте доста́ть для на́шего вояжёра нѣ́сколько рекоменда́тельныхъ пи́семъ и круговóе креди́тное письмо́.

9. При круговóмъ креди́тномъ письмѣ́ ему́ возмо́жно бу́детъ получа́ть доста́точно де́негъ въ ра́зныхъ города́хъ, гдѣ́ онъ бу́детъ остана́вливаться, и такимъ образомъ онъ не будетъ имѣ́ть на́добности вынима́ть потре́бныхъ де́негъ въ одно́й большо́й су́ммѣ за оди́нъ разъ и подверга́ть себя́ изли́шнему ри́ску.

10. Когда́ Вы разсчи́тываете получа́ть отвѣ́ты и запро́сы отъ домо́въ, кото́рымъ Вы сдѣ́лали предложе́нія ?

11. Такъ какъ цѣ́ны това́ровъ, кото́рые мы законтрактова́ли нѣ́сколько мѣ́сяцевъ тому́ наза́дъ, тѣ́мъ вре́менемъ повы́сились, мы полу́чимъ хоро́шій бары́шъ на э́тихъ зака́захъ.

12. Вы должны́ допусти́ть покупа́телей къ соуча́ствованію въ Ва́шемъ до́бромъ сча́стьи и тогда́ они́ о Васъ не забу́дутъ, когда́ имъ на́до бу́детъ дѣ́лать повтори́тельные зака́зы.

13. Ка́ждый благоразу́мный экспортёръ заключа́етъ догово́ръ съ фабрика́нтами на суро́вые това́ры въ тако́е вре́мя, когда́ ры́нокъ вялъ, и́ли, и́наче говоря́, когда́ онъ полага́етъ, что цѣ́ны упа́ли до нижа́йшаго ихъ у́ровня въ да́нный моме́нтъ. Онъ таки́мъ о́бразомъ можетъ получи́ть хоро́шую при́быль на своёмъ суро́вомъ това́рѣ, когда́ цѣ́ны повыша́ются, и, кро́мѣ того́, угоди́ть свои́мъ покупа́телямъ, выполня́я зака́зы по цѣ́намъ нѣ́сколько ни́же услóвленныхъ.

14. Е́сли не разсмо́трите това́ра тща́тельно, Вы едва́ отдѣ́лаетесь отъ прете́нзій, кото́рыя значи́тельно сократя́тъ Ва́шу при́быль.

15. Е́сли найдёте несхо́дства въ ка́чествѣ, отдѣ́лкѣ (аппрету́рѣ) и́ли числѣ́ ни́токъ, Вы, разумѣ́ется, мо́жете получи́ть соразмѣ́рныя усту́пки съ цѣнъ и́ли отказа́ться отъ ку́сковъ.

16. Фабрика́нтъ до́лженъ дать намъ гара́нтію о вознагражде́ніи насъ на слу́чай, е́сли покупа́тель предъя́вить прете́нзію за оши́бочное выполне́ніе зака́за.

17. Кто суть получа́тели э́тихъ мѣ́стъ (тюко́въ) и что они́ содержатъ въ себѣ́ ?

18. Когда́ куски́ бу́дутъ доста́влены, разсмотри́те ихъ, пожа́йлуйста, чрезъ ка́ждый заги́бъ и выбрасывайте всѣ́кій бракъ, такъ какъ то́лько соверше́нный това́ръ до́лженъ быть вы́сланъ.

19. По упако́вкѣ това́ра онъ до́лженъ быть отпра́вленъ къ своему́ мѣ́сту назначе́нія заграни́цей па́русными суднóмъ въ виду́ ни́зкой сто́имости фра́хта.

20. Отсыла́й э́ти ки́пы чрезъ э́того отправи́теля къ желѣ́зно-доро́жной ста́нціи для препровожде́нія къ по́рту и отсы́лкѣ отту́да пе́рвымъ парохо́домъ Вильсонской ли́ніи къ ихъ мѣ́сту назначе́нія.

Exercise 33

1. It is impossible to carry on a business without money. 2. For the benefit of the business we must print new catalogues. 3. I am compelled to leave the goods at (до) your disposal. 4. From Siberia we get eggs and butter. 5. I renounce (abstain from) this uncertain transaction. 6. How much money have you (есть у Васъ) in ready cash ? 7. Through (изъ-за) an empty formality we have lost the steamer. 8. I intend going to (въ, Accusative) London in (чрезъ) a week. 9. He continually sits over (надъ) the books. 10. With (при) sufficient means and plenty of (translate, good) energy a business must flourish. 11. There is no dispute or misunderstanding between him and me. 12. Messrs. S. are thanking us in (въ, Prepositional) the letter for (за) the accurate execution of their order. 13. I cannot let you have this article for a shilling. 14. We shall not manage to finish it in (за) a week. 15. Let us finally set to (за) work (betake ourselves at last to business). 16. You will always find me behind (за) the counter. 17. Send for a ream of packing paper. 18. What a funny question ! 19. I have all the staff before my eyes. 20. The order-book is continually under my hands.

РУ́ССКАЯ КОРРЕСПОНДЕ́НЦІЯ.

Ха́рьковъ, 1-го февраля́ 1913 г.

Господа́мъ

Ста́нли и Дже́фферсонъ,

въ Ма́нчестерѣ, (Великобрита́нія.)

Ми́лостивые Государи́ !

Симъ подтверждаемъ получе́ніе Ва́шего циркуля́ра отъ 3-го п/м. и отъ души́ желаемъ Вамъ до́браго успѣ́ха въ Ва́шемъ благоначина́ніи.

Изъ англійскихъ предме́товъ насъ преиму́щественно интересу́етъ Ше́фильдскій ножевой това́ръ и вообще́ о́стрый инструме́нтъ первокла́сныхъ ма́рокъ, а посему́ про́симъ Васъ при возмо́жности присла́ть намъ В/. прейсъ-кура́нты съ крайнѣ́йшими цѣ́нами.

Въ ожида́ніи пребыва́емъ,

Съ соверше́ннымъ почте́ніемъ,

Б-ья Гри́бовы.

Notes: Великобрита́нія, *Great Britain.* Симъ подтвержда́емъ, *we confirm herewith.* п/м.= про́шлаго мѣсяца, *ultimo, last month.* Отъ души́, *sincerely.* До́браго успѣха, *good success.* Благоначина́ніе, *the good start.* Изъ англій-скихъ предме́товъ, *of the English articles.* Преиму́щественно, *mainly.* Ше́фильдскій, *of Sheffield.* Ножево́й това́ръ, *cutlery.* И вообще́, *and generally.* Острый инструме́нтъ, *sharp tools.* Первокла́сныхъ ма́рокъ, *of the best makes.* А посему́, *therefore.* При возмо́жности, *if possible.* Въ ожида́ніи, *in anticipation.* Пребыва́емъ, *we remain.*

Ки́евъ, февраля, 2-го дня, 1913 го́да.

Господа́мъ,

Ста́нли и Дже́фферсонъ.

въ Ма́нчестерѣ (Англія).

Ми́лостивые Государи́.

Мы надлежа́ще получи́ли Ва́ше почт. письмо́ отъ 3-го п/м. вмѣстѣ съ прейсъкура́нтомъ и образца́ми, за что Васъ премно́го благодари́мъ.

Къ сожалѣнію, мы не нахо́димъ тепе́рь для себя́ удо́бнымъ удовлетвори́ть Васъ зака́зомъ, но при пе́рвой на́добности мы Вамъ сообщи́мъ.

Съ соверше́ннымъ почте́ніемъ

Бончко́вскій и Кру́лекъ.

Notes: Надлежа́ще, *duly.* Почт.=почтѣнное, *esteemed.* Вмѣстѣ, *together.* За что, *for which.* Премно́го, *very much.* Къ сожалѣнію, *to our regret.* Не нахо́димъ для себя́ удо́бнымъ, *we do not find it convenient.* Удовлетвори́ть Васъ, *to satisfy you.* При пе́рвой на́добности, *as soon as we shall require any goods.* Мы Вамъ сообщи́мъ, *we will communicate with you.*

Form of a Bill of Exchange

Фо́рма ве́кселя.

Москва́, 20 января́ 1913 г.

Ве́ксель на 2,000 Рубле́й.

20 ма́я 1913 го́да по сему́ ве́кселю повиненъ я заплати́ть Ма́нчестерскимъ купца́мъ Ста́нли и Дже́ффер-сонъ ДВѢ ТЫСЯЧИ РУБЛЕЙ

Мѣсто платежа́: Ру́сскій для Внѣшней Торго́вли Банкъ въ Ло́ндонѣ.

Моско́вскій купе́цъ Михаи́лъ Семе́новичъ Долгору́ковъ.

Notes: По сему́ ве́кселю, *against this bill.* Повиненъ я заплати́ть, *it is incumbent upon me to pay.* Купца́мъ, *to the merchants.* Мѣсто платежа́, *domicile* (place of payment). Ру́сскій для внѣшней торго́вли Банкъ, *the Russian Bank for foreign trade.*

(Other forms to follow.)

Advice of a Traveller's Visit.

Извѣще́ніе о посѣщеніи представи́теля.

Ма́нчестеръ, 25 Января́ 1913 го́да.

Господа́мъ,

Т. Попо́въ и Ко.

въ С. Петербу́ргѣ (Petrograd).

Ми́лостивые Государи́!

Симъ имѣемъ честь Васъ извѣсти́ть, что нашъ представи́тель, г. То́масъ Грантъ, сдѣлаетъ себѣ вско́рѣ удово́льствіе посѣти́ть Ва́шу уважа́емую фи́рму и предложи́ть Вамъ на́ши новѣ́йшіе фабрика́ты.

Поко́рнѣйше просимъ Васъ резерви́ровать для него́ Ва́ши зака́зы, за что предпосыла́емъ Вамъ зара́нѣе на́шу и́скреннюю благода́рность.

Съ и́стиннымъ уваже́ніемъ,

Ста́нли и Дже́ффферсонъ.

Notes: Представи́тель, *representative.* Сдѣлаетъ себѣ вско́рѣ удово́льствіе, *will have soon the pleasure.* Посѣти́ть (P), *to visit.* Уважа́емую, *esteemed.* Предложи́ть (P), *to submit, offer.* Фабрика́ты, *manufactures.* Резерви́ровать (Imp.), *to retain, keep in reserve.* Предпосыла́емъ зара́нѣе, *we send in advance.* Искреннюю благода́рность, *sincere thanks.* Съ и́стиннымъ уваже́ніемъ, *with true esteem.*

Key to Exercise 18

1. Your representative has paid me a visit last week. 2. We shall meet in London. 3. I awaited this opportunity for two years. 4. Pay me my money. 5. Do not shout. I shall pay you the money in a month's time. 6. On the way I went in to the merchant D. 7. I have made a note of your address in my pocket-book. 8. I shall come to see you this evening. 9. When will my goods go off? 10. They went off yesterday. 11. Take away your samples. 12. Your goods are of no use. 13. You have overcharged me one rouble on every article. 14. It is not my fault: goods have become dearer. 15. Why have you not asked me? 16. I did ask you several times. 17. Oh, yes, I forgot about this. 18. Have you already received my draft? 19. When have you sent it out? 20. You will receive it to-morrow morning without fail.

Key to Exercise 19

1. Я посѣщу́ Васъ чере́зъ недѣ́лю. 2. Что Вы ку́пите сего́дня? 3. Я ничего́ не куплю́. 4. Гдѣ встрѣ́тимся за́втра? 5. Я обожду́ Васъ на углу́. 6. Что Вы заплати́ли за ковры́?

Key to Exercise 20

1. I have taken over the grandfather's ironmongery shop. 2. When will you give me an order at last? 3. Do not be disheartened: I shall give soon a huge order. 4. My leathern portfolio is lost. 5. I have got for you some cheap goods. 6. I am not interested in cheap articles. 7. I wish to buy a fox fur coat. 8. I congratulate you on the New Year. 9. Where have you put the Russian letters? 10. I have seen no Russian letters. 11. How much have you paid for the gold watch? 12. From whom have you got this gold chain? 13. I have bought it in the new shop. 14. An old servant is better than two young ones. 15. Are you satisfied with the new manager? 16. I highly appreciate his great business experience. 17. I understand neither head nor tail of your trading expenses. 18. I advise you to introduce the strictest economy. 19. Accept my sincere assurance of the exact execution of your order. 20. Anticipating your esteemed news I remain, Yours faithfully.

Key to Exercise 21

1. Наста́ли до́лгіе дни. 2. Я и́щу бѣ́лыхъ шерстяны́хъ мате́рій. 3. Э́та мате́рія сдѣлана изъ ко́зьяго во́лоса. 4. Я живу́ въ до́мѣ. 5. Мы рабо́таемъ съ ра́ннаго утра́. 6. Ско́лько рабо́чихъ Вы занима́ете въ пако́вочномъ отдѣле́ніи? 7. Мы торгу́емъ золоты́ми и серебряными издѣ́ліями. 8. Возьми́ кре́пкія бичёвки для э́тихъ посы́локъ. 9. Я не дово́ленъ тепе́решнимъ счётомъ. 10. Вы тамъ наста́вили чрезмѣ́рныя цѣны.

A. C.

GREEK.—VII

Demonstrative Pronouns

The demonstrative pronouns are ὅδε, *this* (here or by me), οὗτος, *this*, and ἐκεῖνος, *that*, and are declined as follows:—

	Singular.			*Plural.*		
	Masc.	*Fem.*	*Neut.*	*Masc.*	*Fem.*	*Neut.*
Nom.	ὅδε	ἥδε	τόδε	οἵδε	αἵδε	τάδε
Gen.	τοῦδε	τῆσδε	τοῦδε	τῶνδε	τῶνδε	τῶνδε
Dat.	τῷδε	τῇδε	τῷδε	τοῖσδε	ταῖσδε	τοῖσδε
Acc.	τόνδε	τήνδε	τόδε	τούσδε	τάσδε	τάδε

Dual.

	Masc., Fem., and Neut.
N.A.	τώδε
G.D.	τοῖνδε

	Singular.			*Plural.*		
	Masc.	*Fem.*	*Neut.*	*Masc.*	*Fem.*	*Neut.*
Nom.	οὗτος	αὕτη	τοῦτο	οὗτοι	αὗται	ταῦτα
Gen.	τούτου	ταύτης	τούτου	τούτων	τούτων	τούτων
Dat.	τούτῳ	ταύτῃ	τούτῳ	τούτοις	ταύταις	τούτοις
Acc.	τοῦτον	ταύτην	τοῦτο	τούτους	ταύτας	ταῦτα

Dual.

	Masc., Fem., and Neut.
N.A.	τούτω
G.D.	τούτοιν

	Singular.			*Plural.*		
	Masc.	*Fem.*	*Neut.*	*Masc.*	*Fem.*	*Neut.*
Nom.	ἐκεῖνος	ἐκείνη	ἐκεῖνο	ἐκεῖνοι	ἐκεῖναι	ἐκεῖνα
Gen.	ἐκείνου	ἐκείνης	ἐκείνου	ἐκείνων	ἐκείνων	ἐκείνων
Dat.	ἐκείνῳ	ἐκείνῃ	ἐκείνῳ	ἐκείνοις	ἐκείναις	ἐκείνοις
Acc.	ἐκεῖνον	ἐκείνην	ἐκεῖνο	ἐκείνους	ἐκείνας	ἐκεῖνα

Dual.

	Masc., Fem., and Neut.
N.A.	ἐκείνω
G.D.	ἐκείνοιν

The pronoun ὅδε, ἥδε, τόδε is made up of the article ὁ, ἡ, τό, and the particle -δε. ἐκεῖνος is quite regular except in the nom. and acc. neut. sing.

Used in agreement with a substantive, these pronouns go in the predicative position, the substantive being preceded by the article, as in οὗτος ὁ βασιλεύς or ὁ βασιλεὺς οὗτος, *this king*, ἡ γυνὴ ἐκείνη, *that woman*, τοῦτο τὸ πρᾶγμα or τὸ πρᾶγμα τοῦτο, *this matter*, or ἐκεῖνος ὁ λίθος, *that stone*.

Like οὗτος are declined:—

τοσοῦτος, τοσαύτη, τοσοῦτο, *so great, so much* (tantus).
τοιοῦτος, τοιαύτη, τοιοῦτο, *such* (talis).
τηλικοῦτος, τηλικαύτη, τηλικοῦτο, *so old*.

Remark however that the neuter singular, besides the form in ο, has the following forms in -ον:—

τοσοῦτον, τοιοῦτον, τηλικοῦτον.

Interrogative and Indefinite Pronouns

The interrogative τίς, τί, *who, which, what?* and the indefinite τις, τι, *someone, anyone, something*, are thus declined:—

	Interrogative.		*Indefinite.*	
	Singular.			
	M. and F.	*N.*	*M. and F.*	*N.*
Nom.	τίς	τί, *what?*	τις	τι
Gen.	τίνος or τοῦ		τινός or του	
Dat.	τίνι or τῷ		τινί or τῳ	
Acc.	τίνα	τί	τινά	τι
	Plural.			
Nom.	τίνες	τίνα	τινές	τινά or ἄττα
Gen.	τίνων		τινῶν	
Dat.	τίσι (ν)		τισί (ν)	
Acc.	τίνας	τίνα	τινάς	τινά or ἄττα
	Dual.			
N.A.	τίνε		τινέ	
G.D.	τίνοιν		τινοῖν	

The indefinite τις, τι is enclitic, that is, it is pronounced as if it were a part of the preceding word, as in σοφόν τι. The acute accent of τίς, τί, never changes to a grave. Ἄλλος, ἄλλη, ἄλλο, *other*, is declined like αὐτός. The negative compounds of τις, namely, οὔτις, οὔτι, μήτις, μήτι (poetic for οὐδείς, οὐδέν, μηδείς, μηδέν), *no one, nothing*, follow the simple τις. Thus, οὔτις, οὔτινος, οὔτινι, οὔτινα, οὔτι, οὔτινες, οὔτινα, etc.

Relative Pronouns

There are two relative pronouns ὅς, ἥ, ὅ, *who, which*, and ὅστις, ἥτις, ὅ τι, *whoever, whatever*, which are declined as follows:—

	Singular.			*Plural.*		
Nom.	ὅς	ἥ	ὅ	οἵ	αἵ	ἅ
Gen.	οὗ	ἧς	οὗ	ὧν	ὧν	ὧν
Dat.	ᾧ	ᾗ	ᾧ	οἷς	αἷς	οἷς
Acc.	ὅν	ἥν	ὅ	οὕς	ἅς	ἅ
	Dual.					
N.A.	ὥ		ὥ		ὥ	
G.D.	οἷν		οἷν		οἷν	

	Singular.		
Nom.	ὅστις	ἥτις	ὅ τι
Gen.	οὑτινος or ὅτου	ἧστινος	οὑτινος or ὅτου
Dat.	ὥτινι or ὅτῳ	ᾗτινι	ὥτινι or ὅτῳ
Acc.	ὅντινα	ἥντινα	ὅ τι
	Plural.		
Nom.	οἵτινες	αἵτινες	ἅτινα or ἄττα
Gen.	ὧντινων or ὅτων	ὧντινων	ὧντινων or ὅτων
Dat.	οἷστισι or ὅτοις	αἷστισι	οἷστισι or ὅτοις
Acc.	οὕστινας	ἅστινας	ἅτινα or ἄττα
	Dual.		
N.A.	ὥτινε		
G.D.	οἵντινοιν or ὅτοιν		

Ὅστις is formed by the union of the relative ὅς with the indefinite τις. It denotes a general or indefinite class, and is called the indefinite relative. You will observe that each of its constituent parts is declined separately. ὅ τι is written thus to distinguish it clearly from the conjunction ὅτι, *that*.

The use of the indefinite relative is brought out in a comparison of a direct with an indirect interrogative, thus:—

Interrogative.	τίς γράφει ταύτην τὴν ἐπιστολήν; *Who writes this letter?*
Indefinite.	λέγε μοι ὅστις ταύτην τὴν ἐπιστολὴν γράφει. *Tell me who writes this letter.*
Direct Interrogative.	τί φροντίζεις; *What are you worrying about?*
Indirect Interrogative.	οὐ λέγω ὅ τι φροντίζω. *I tell not what I am worrying about.*

Pronominal Adjectives and Adverbs

There are a number of adjectives and adverbs which have reciprocal relations to each other

analogous to those of interrogative, indefinite, demonstrative, and relative pronouns, as τίς; *who?* τις, *anyone,*; ὅδε or οὗτος, *this, this one*; ὅς or ὅστις, *who, which.*

Thus, πόσος; *how much?* (Latin quantus?) asks a question which is answered by τόσος, *so much* (tantus). Ποσός may also signify *of some size* (aliquantus), and so become indefinite; and if we wish to say "I know not how much," we employ ὅσος or ὁπόσος, and so call into use a relative and dependent form.

(*a*) The following are the chief of these adjectives:—

Interrogative.	*Indefinite.*	*Demonstrative.*	*Relative.*
πόσος, -η, -ον; *how great? how much?* (quantus?)	ποσός, -ή, όν, *of a certain size.*	[τόσος, poetic] τοσόσδε or τοσοῦτος, *so much* (tantus).	ὅσος, -η, -ον, ὁπόσος, -η, -ον, *as much, as many* (quantus).
ποῖος, -α, -ον; *of what kind?* (qualis?)	ποιός, -ά, -όν, *of a certain kind.*	[τοῖος, -α, -ον, poetic] τοιόσδε or τοιοῦτος, *such, of that kind* (talis).	οἷος, -α, -ον, ὁποῖος, -α, -ον, *of which kind, as* (qualis).
πηλίκος, -η, -ον; *of what age? of what size?*	—	[τηλίκος, -η, -ον, poetic] τηλικόσδε, τηλικοῦτος *of that age, of that size.*	ἡλίκος, -η, -ον, ὁπηλίκος, *of which age, of which size* (as old or as large) *as.*
πότερος, *which* (of two)?	πότερος or ποτερός, *one* (of two).	ἕτερος, *the one* or *the other* (of two).	ὁπότερος, *whichever* (of two).

As already mentioned τοσοῦτος, τοιοῦτος, and τηλικοῦτος, are declined like οὗτος, except that there are neuter singular forms in -ον as well as the forms in ο. Τοσόσδε, τοιόσδε, and τηλικόσδε, are declined like τόσος, etc., the -δε being an indeclinable enclitic.

(*b*) The following are the chief of these pronominal adverbs:—

Interrogative.	*Indefinite.*	*Demonstrative.*	*Relative.*
πῇ, *which way? how?*	πῃ, *somehow*	τῇ, τῇδε, ταύτῃ, *there, this way, thus.*	ᾗ, ὅπῃ, *which way, as.*
πηνίκα, *at what time?*		τηνίκα τηνικάδε τηνικαῦτα, *at that time.*	ἡνίκα ὁπηνίκα, *when.*
πόθεν, *whence?*	ποθέν, *from somewhere.*	τόθεν ἔνθεν, ἐκεῖθεν, *thence.*	ὅθεν ὁπόθεν, *whence.*
ποῖ, *whither?*	ποι, *some whither.*	ἐκεῖσε, *thither.*	οἷ, ὅποι, *whither.*
πότε, *when?*	ποτέ, *at some time.*	τότε, *then.*	ὅτε, ὁπότε, *when.*
ποῦ, *where?*	που, *somewhere.*	ἔνθα, ἐνταῦθα, οὗ, ἐκεῖ, *there.*	ὅπου, *where.*
πῶς, *how?*	πως, *somehow*	ὧς, ὧδε, οὕτως, ὡς ὅπως, *how, thus.*	

The enclitic -γε is sometimes appended to personal pronouns in the first and second person, in order to give force and prominence to the word, as ἐγώγε, ἐμοίγε, ἐμοῦγε, ἐμέγε, σύγε, etc.

The particles δή, δήποτε, and οὖν are added to interrogative and indefinite pronouns and to ὅσος, to give them a general application, such as the sense conveyed by the English enclitics *-ever* and *-soever*, in *whenever whatsoever, where soever*, etc.

For example ὅστις δή, ὅστις δήποτε, ὁστισοῦν, ἡτισοῦν ὁτιοῦν, *whoever, whosoever, whatsoever, etc.*, the genitive ὁτουοῦν, ἡστινοσοῦν; dative ὁτῳοῦν, etc.

Similarly, the enclitic περ is affixed to relatives, giving them a demonstrative sense or making them emphatic, as in ὥσπερ, ἥπερ, ὅπερ, *who* or *what indeed.* So also ὅστισπερ, οἵοσπερ, etc.

The long ί (before which a long vowel is dropped) is affixed to demonstratives as well as some adverbs to augment the demonstrative force, being equivalent to our vulgar *there*, in *that man there* or *that there man.* This use may be compared with that of the Latin *ce* in *hicce*, etc., or the French *ci*, as in *celui-ci.* This ί always has the acute accent, thus:—

	Singular.		
	Masc.	*Fem.*	*Neut.*
N	οὑτοσί, *that man.*	αὑτηί, *that woman.*	τουτί, *that thing.*
G.	τουτουί	ταυτησί	
D.	τουτῳί	ταυτῃί	
	Plural.		
N.	οὑτοιί	αὑταιί	ταυτί

So ὁδί, ἡδί, τοδί, from ὅδε; οὑτωσί, from οὕτως, ἐνθαδί, νυνί, δευρί.

VOCABULARY

ἄφρων, -ον, gen. -ονος, *senseless.*
βλαβερός, -ά, -όν, *hurtful.*
κακοῦργος, -ον, *hurtful, evil-doing* (with gen.).
περιφέρω, *I carry about.*
πλεονέκτης -ου, ὁ, *a greedy* or *avaricious person.*
πλουτίζω, *I enrich.*
χαρίζομαι, *I gratify.*
ὠφέλιμος, -ον, *useful, advantageous.*

Exercise 7

(*a*) Translate into English:—

1. Ἀγαθοὶ παῖδες ἀλλήλους στέργετε. 2. Ὁ ἀκρατὴς οὐκ ἔστι τοῖς μὲν ἄλλοις βλαβερὸς ἑαυτῷ δὲ ὠφέλιμος, ἀλλὰ κακοῦργος μὲν τῶν ἄλλων ἑαυτοῦ δὲ πολὺ κακουργότερος. 3. Ὑμῖν αὐτοῖς χαρίζεσθε. 4. Ὁ πλεονέκτης ἑαυτὸν μὲν πλουτίζει, ἄλλους δὲ βλάπτει. 5. Οἱ σοφοὶ περιφέρουσι τὰ πράγματα ἐν ἑαυτοῖς. 6. Ὁ σὸς πατήρ ἐστιν ἀγαθός.

(*b*) Translate into Greek:—

1. The wise man carries his possessions about in himself. 2. Speak the praise of thy friends rather than thine own. 3. Know thyself. 4. Life brings many griefs with it. 5. Virtue is beautiful in itself. 6. The avaricious enrich themselves, but injure others.

Key to Exercise 6

(*a*) 1. We two write, but you two play. 2. We write but you play. 3. Listen to us, boy! 4. God always sees you. 5. If I harm you, you do not rejoice with me. 6. You rejoice with us.

(*b*) 1. Ὦ παῖ ἄκουε μοῦ. 2. Ὁ θεὸς ἀεί σε βλέπει. 3. Σέβομαί σε, ὦ μεγαλε Ζεῦ. 4. Ἐγὼ μὲν γράφω, σὺ δὲ παίζεις. 5. Εἰ με βλάπτεις οὐκ ἐχθρῶν διαφέρεις. 6. Ἐγώ σου ἐρρωμενέστερός εἰμι.

E. A. B.

ITALIAN.—VII

Reflective Verb, as also the *Passive Voice* and the *Impersonal Verb*, take the auxiliary **éssere** in the compound tenses, whereas in English the verb "to have" is used.

Examples:—

(*a*) *Reflexive:* Si sono alzati, *they have got up* (literally, they are raised themselves up).
Mi si è detto tutto, *I have been told all* (literally, one has (or is) told to me all).

Note.—This SI is often called an impersonal indefinite pronoun, corresponding to *one* in English and to *on* in French.

(*b*) *Passive:* Siamo stati pagati, *we have been paid.*
(*c*) *Impersonal:* Era bastato, *it had* (was) *sufficed.*
E piovuto, *it has* (is) *rained.*

Avere, Essere, *Past (Imperfect) Tense*

AVERE, *to have*

Sing.	*Plur.*
1. Avevo (aveva), *I had.*	avevamo, *we had.*
2. Avevi, *thou hadst.*	avevate, *you had.*
3. Aveva, *he* (she, it) *had.*	avévano, *they had.*

ÉSSERE, *to be*

Sing.	*Plur.*
1. Ero (era), *I was.*	eravamo, *we were.*
2. Eri, *thou wast.*	eravate, *you were.*
3. Era, *he* (etc.) *was.*	érano, *they were.*

Examples:—

Avevo ricevuto le mie rimesse stamattina (stamane) dal portalettere (postino).	*I had received my remittances this morning from the postman.*
I portaléttere (postini) ci avévano dato la nostra corrispondenza.	*The postmen had given us our correspondence.*
I loro conti érano divenuti più grandi (avevano assunto maggior proporzione) dei (che i; di or che = *than*) miei.	*Their accounts had* (were) *become greater than mine.*
Dove érano i suói (i di lui) bastimenti?	*Where were his ships?*
Cercávano il loro fratello,	*They were looking for their brother.*

The possessive adjective **loro** is always preceded by the definite article, even before a relative, as here.

Eravate nella casa tre ore.	*You were in the house three hours.*

By prefixing the characteristic vowel of the conjugations to the following endings we get the Imperfect Indicative:—

-vo (va), -vi, -va, -vamo, -vate, -vano

FIRST OR **A** CONJUGATION

Sing.	*Plur.*
1. Compravo (comprava)	compravamo.
2. Compravi	compravate.
3. Comprava	comprávano.

SECOND OR **E** CONJUGATION

Sing.	*Plur.*
1. Vendevo (vendeva)	vendevamo.
2. Vendevi	vendevate.
3. Vendeva	vendévano.

THIRD OR **I** CONJUGATION

Sing.	*Plur.*
1. Partivo (partiva)	partivamo.
2. Partivi	partivate.
3. partiva	partívano.

The imperfect tense in Italian corresponds to continuous or repeated action or state in the past, and often may be translated into English by *was doing* or *used to do*, etc. There is another past tense called the Past Definite, which refers to an action performed and definitely concluded at some expressed or understood time. In a later lesson the Past Definite tense will be fully dealt with.

Miscellaneous examples:—

Pagátoci (past part. used without auxiliary verb) il saldo, null' altro chiediamo.	*The balance* (being) *paid to us, we ask for nothing more.*
Pagátaci la somma, possiamo eseguire l'ordine.	*As the amount is paid, we may execute the order.*
Vendétegli (affirm. imp.) tutto quello che domanda.	*Sell* (to) *him all that* (which) *he asks for.*
Le parole che ci scrivete.	*The words you write to us.*

Which, often omitted in English, must always be expressed in Italian.

Quando parte egli per Firenze?	*When does he leave for Florence?*
Non ne parlate.	*Do not speak of it* (of them, etc.).
Che ne pensate (pensare di)?	*What do you think about it* (viz. what is your opinion about it)?
Non ci penso (pensare a) nemmeno.	*I do not even think about it* (viz., it does not enter my thoughts).
Gli ho detto tutto.	*I have told him everything.*
Che ne pénsano loro?	*What do they think of it?*
Comprate del panno o degli stampati?	*Are you buying some* (woollen) *cloth or some prints* (printed calico)?

Of the (*del* and *degli* in this case) is used like the French *du*, etc., to form the partitive, viz., to express a part of the object.

Ne finíscono una parte oggi.	*They are finishing a part of it to-day.*
Non ne compriamo mai.	*We never buy any.*
Vendétegliene.	*Sell some of it to him* (or to her).

Gli, preceding and joined to the pronouns **lo**, **la**, **li**, **le**, and **ne**, adds the letter **e**, as gliélo, gliéli = *it to him, them to him* (literally, to him it, to him them). Observe that these combinations are written as one word.

Mi si dice.	*I am told.*
Vi si dice.	*You are told.*
Ci si dice.	*We are told.*

In this usage the **i** of **mi**, etc., does not change to **e**, because **si** is here taken as an indefinite, not a conjunctive, pronoun.

Mi si dice che è vero.	*I am told that it is true* (lit. it says itself to me that it is true; corresponding to the English passive "I am told" or "People tell me," etc.).
Ci si dice che non dobbiamo ritornare oggi.	*We are told* (it says itself to us, they tell us) *that we must not return to-day.*

The pronoun **le**, *to her, to it* (f.), becomes **glie** (like **gli**, given above), for the sake of euphony, as Gliene (= le ne) ho dato, *I have given some to her.* This rule applies when **le** is followed by one of the pronouns **lo**, **la**, **li**, **le**, **ne**, in which case they are written in one word.

VOCABULARY

alzarsi, *to get up.*
bastare, *to suffice.*
pióvere, *to rain.*
piovuto, *rained.*
a saldo, *in balance.*
il saldo, *balance.*
la somma, *sum.*
tutto quello (che), *all that* (which).
Firenze, *Florence.*
i stampati, *prints.*
la parte, *part.*
i di lúi, Poss. adj. 3rd pers. pl., *his.*
cercare, *to look for.*
il fratello, *brother.*
conforme, *according.*
spedire, *to send.*
franco a bordo, f.a.b., *free on board.*
il montante, *amount.*
tirare, *to draw.*
do (dare), *I give.*
mi piace, *it pleases me, I am glad.*
si diceva (past impf. of *dire*), *it was said, told.*
pomeridiano (adj.) *afternoon.*
sentirsi male, *to feel ill.*
lo studio, *office.*
il giornale, *journal* (account-book).
fatturare, *to invoice.*
greggio, *grey.*
indicare, *to indicate, mention.*
la móglie (la sposa), *wife.*
la madre, *mother.*
la fíglia, *daughter.*
ciò che, *that which, what.*
per piacere, *if you please.*
può (from *potere*), (he) *can, may.*
aumentarsi, *to increase itself.*
ammalato, *ill.*
accludere, *to enclose.*
vedrete, *you will see.*
c'e, *there is.*
lo sbaglio, *mistake.*
opportunamente, *in due course.*
il dettaglio, *detail.*
il salario, *salary.*
sicuro, (it is) *certain.*
lúi stesso, *he himself.*
trovarsi, *to be, to find oneself.*
antemeridiano (adj.), *morning.*
i dettagli, *details.*
appunto (como), *just* (as).
il corriere, *post, mail.*
abbisognare, *to want, need.*
chiesto (from *chiédere*), *asked.*

Exercise 13

Translate into English:—

1. Conforme al di lúi desidério, le (say, le balle) spedivamo sempre franco a bordo Liverpool. 2. Spieghiamo loro quest' affare! (Imp.). 3. Non pagate loro il montante, pagátelo al cassiere. 4. Ecco la cambiale che avévano tirata sul negoziante, ve la do adesso invece di domani. 5. Mi piace questa qualità, comprátemela (imp.) allo stesso magazzino. 6. Fátemi (imp.) questo favore, ve ne prego. 7. Mi si diceva che il di lúi (of him = his) salario era amuentato del dieci per cento; è vero? 8. Sicuro che è certo, me l'ha detto lúi stesso. 9. Ci trovavamo sempre a casa alle dieci antemeridiane e alle tre del pomeriggio (or, alle tre pomeridiane). 10. Siete certi (pl.) di trovárvici? (*Vi* = you; *ci* = there). 11. Díteglielo súbito, ve ne preghiamo, e se abbisogna di altri campioni, mandátegliene col próssimo corriere.

Exercise 14

Translate into Italian:—

1. If he likes the goods, give him as many more as he wants. 2. In accordance with your wish, we awaited the patterns before saying (tr. to say) what (cio che) we thought. 3. Explain to me this matter, if you please. 4. I am told (tr. to me itself (acc.) it says) that they manufacture this article. 5. Do not pay the amount to me to-day; pay it to me (tr. to me it) to-morrow. 6. Do you not see the prices, here they are! 7. Here are the bills of exchange (which) you mention. 8. If this quality pleases you, buy it for (to) him. 9. He was told (tr. to him itself it said) that your salary may be increased by five per cent. 10. You say that he has told it you himself. Are you sure of it? 11. Do you feel very bad? Tell me what ails you (tr. what you have). 12. What do they think of it?

Key to Exercise 5

1. We have sent some patterns to the good customers. 2. I have spoken of a man whom I know. 3. The Italians who are here have paid the account. 4. Is it time to go to the theatre? 5. We are glad to tell you that the friends have arrived. 6. Have you received a bill of lading from the shipper (carrier, forwarding-agent)? 7. Have the remittances come from the customers? 8. Two hours before leaving (departing) I have seen the representative of the house. 9. I have given the books to the book-keeper. 10. In the affirmative case have the goodness to write to the correspondent. 11. On the cases in the warehouses (shops) I have noticed certain curious marks. 12. They have come by the first train. 13. I come now from the customer who has been at the merchant's. 14. We have been (have gone, went) to him (to his house) in order to converse a little on things in general. 15. They have accepted the goods on (according to) the definite guarantee of the manufacturers. 16. You have entered the houses in (of) the cities which you have visited in order to examine the new designs. 17. I have done it expressly for the buyers of the important foreign houses. 18. It is a beautiful design and we have sold great lots of it. 19. Let us speak no more of the bad years, but let us speak of the good (ones). 20. We are sure that our goods will have an excellent sale in your city.

A. C.

SPANISH.—VII

Subjunctive Mood.—As shown in the Third Lesson, **cuàndo**, *when*, not used interrogatively, nor meaning *whenever*, is followed by the Present Subjunctive, when referring to some event which is still to take place.

Si, *if*, not meaning whether, is used with the Imperfect and Conditional Subjunctive, but, when dealing with the present time, it requires the Present Indicative, *not* the Present Subjunctive after it, though we find the Future Subjunctive following both **si** and **cuàndo** in some very rare instances in the literary style.

The Subjunctive Mood will be dealt with in full in later lessons, meanwhile we give all its four tenses, Present, Imperfect, Future, Conditional.

Present Subjunctive

	yo	tú	él (èlla, V.)	nosòtros (-as)	vosòtros (-as)	èllos (èllas, Vs.)	
1. Còmpr	-e	-es	-e	-èmos	-éis	-en	*I buy*, etc.
2. Vènd	-a	-as	-a	-àmos	-áis	-an	*I sell*, etc.
3. Sùpl							*I supply*, etc.

Imperfect Subjunctive

1. Còmpr	-àse	-àses	-àse	-ásemos	-àseis	-àsen	*I bought*, etc.
2. Vènd	-ièse	-ièses	-ièse	-iésemos	-ièseis	-ièsen	*I sold*, etc.
3. Sùpl							*I supplied*, etc.

Future Subjunctive

1. Còmpr	-àre	-àres	-àre	-áremos	-àreis	-àren	*I shall buy*, etc.
2. Vènd	-ière	-ières	-ière	-iéremos	-ièreis	-ièren	*I shall sell*, etc.
3. Sùpl							*I shall supply*, etc.

Conditional Subjunctive

1. Còmpr	-àra	-àras	-àra	-áramos	-àrais	-àran	*I should buy, thou wouldst buy*, etc.
2. Vènd	-ièra	-ièras	-ièra	-iéramos	-ièrais	-ièran	*I should sell*, etc.
3. Sùpl							*I should supply*, etc.

An easy way to form the *Present Subjunctive* is to take the stem of the Present Indicative and change the final **o** into the following endings respectively :—

1st Conjugation—

	-e	-es	-e	-èmos	-éis	-en.

2nd and 3rd Conjugations—

	-a	-as	-a	-àmos	-áis	-an.

This rule applies also, with few exceptions which will be given in a later lesson, to all the irregular verbs, as may be seen from: **vengo**, *I come*, First Person, Present Indicative of **venìr**, viz.:

Present Subjunctive: vènga, vèngas, vènga, vengàmos, vengáis, vèngan.

The Imperfect, Future and Conditional Subjunctive are respectively formed, *without a single exception* both in regular and irregular verbs, by substituting the following endings for the termination -RON of the Third Person Plural of the Past Definite:

For all three Conjugations

Imperfect Subjunctive

	-se	-ses	-se	-semos	-seis	-sen.

Future Subjunctive

	-re	-res	-re	-remos	-reis	-ren.

Conditional Subjunctive

	-ra	-ras	-ra	-ramos	-rais	-ran.

Imperative Mood.—The Imperative is either *Affirmative or Negative*. The Affirmative forms its Second Person Singular (familiar, **tú**, *thou*) from the same person of the Present Indicative, by dropping the final **s** of latter, whilst it forms its Second Person Plural (familiar *you*, **vosòtros**) by substituting **d** for the final **r** of the Infinitive. The First Person Plural and the Third Person Singular and Plural, as also all the persons of the *Negative Imperative*, are simply borrowed from the Present Subjunctive.

Affirmative Imperative

First Conjugation

Sing.	*Plur.*
1. (Never used.)	comprèmos, *let us buy.*
2. còmpra, *buy* (thou—fam.).	compràd, *buy* (you—fam.).
3. còmpre, *let him buy.*	còmpren, *let them buy.*
còmpre, V., *buy* (you—polite).	còmpren Vs., *buy* (you—polite, plur.).

Second Conjugation

Sing.	*Plur.*
1. (Not used.)	vendàmos, *let us sell.*
2. vènde, *sell* (fam.).	vendèd, *sell* (fam.).
3. vènda, *let him sell.*	vèndan, *let them sell.*
vènda V., *sell* (polite).	vèndan Vs., *sell* (polite, plur.).

Third Conjugation

Sing.	*Plur.*
1. (Not used.)	suplàmos, *let us supply.*
2. sùple, *supply* (fam.).	suplid, *supply* (fam.).
3. sùpla, *let him supply.*	sùplan, *let them supply.*
sùpla V., *supply* (polite).	sùplan Vs., *supply* (polite, plur.).

Negative Imperative

First Conjugation

Sing.	*Plur.*
1. (Not used.)	no comprèmos, *do not let us buy.*
2. no còmpres, *do not buy* (fam.).	no compréis, *do not buy* (fam.).
3. no còmpre, *do not let him buy.*	no còmpren, *do not let them buy.*
no còmpre V., *do not buy* (polite).	no còmpren Vs., *do not buy* (polite, plur.).

Second Conjugation

Sing.	*Plur.*
1. (Not used.)	no vendàmos, *do not let us sell.*
2. no vèndas, *do not sell* (fam.).	no vendáis, *do not sell* (fam.).
3. no vènda, *do not let him sell.*	no vèndan, *do not let them sell.*
no vènda V., *do not sell* (polite).	no vendan Vs., *do not sell* (polite, plur.).

Third Conjugation

Sing.	*Plur.*
1. (Not used.)	no suplàmos, *do not let us supply.*
2. no sùplas, *do not supply* (fam.).	no supláis, *do not supply* (fam.).
3. no sùpla, *do not let him supply.*	no sùplan, *do not let them supply.*
no sùpla V., *do not supply* (polite).	no sùplan Vs., *do not supply* (polite, plur.).

Note: The polite pronoun **V.** or **Vs.** must always follow both the affirmative and negative forms of the imperative, as its omission would be discourteous. As regards the Future Subjunctive, this tense is now scarcely ever used even in literature, and certainly never in the commercial style, but a few examples are here given to familiarise the student with it, as a part of the verb. The conditional Subjunctive frequently replaces the Imperfect Subjunctive, and in many instances it also takes the place of the Conditional Indicative.

Examples

Descarían (or Cond. Subj., deseàran) sabèr si Vs. han recibìdo la càrta.
They would like to know if (whether) you have received the letter.

Querríamos (Indicative Conditional of querer, or quisièran, third person, plural, Past Definite is quisièron) decìr á V. ùna palàbra.
We should like to say a word to you.

Quisiéramos (or querríamos) entràr en relaciònes comerciàles con la estimàda càsa de Vs.
We should like to enter into business relations with your esteemed firm.

Diga V. (Imperative of decìr) al cliènte que harèmos (Future Indicative of hacèr) nuèstro posìble pàra ejecutàr el pedìdo.
Tell the customer that we shall do our best to execute the order.

Quièro que V. le dìga la verdàd.
I wish you to tell him the truth.

Remark: It would be wrong to translate the English literally into Spanish as **Quièro V. decìrle la verdàd,** because the subject of **decìrle** is different from the subject of **quièro,** and in such cases the English infinitive must be rendered in Spanish by the corresponding finite tense, as shown in this example.

Si quisiésemos (or quisiéramos) hacèr èsto, lo haríamos.
If we wished to do this, we should do it.

Cuàndo V. tènga (Pres. Subj. of tenèr, *to have*, third person plural Past Definite tuvièron) el tièmpo, escríbame V. un renglón.
When you have the time, write me a line.

Remark: In literature **tuvière** could replace **tènga** in this example, though the

Future Subjunctive is rarely used nowadays, and *never* in business.

Si vendèmos (rarely, and only in literature, vendiéremos) los géneros á èse prècio, perderèmos mùcho dinèro.

If we sell the goods at that price, we shall lose much money.

Si comprásemos (or compráramos) la tèla crùda al mìsmo prècio, haríamos un diez por ciènto de ganància.

If we bought the grey cloth at the same price, we should make a profit of ten per cent.

Note: The student is recommended to study again the rules as to stress, given in the First Lesson, as the grave accent will not be used after this lesson.

VOCABULARY

las relaciònes comerciàles, *business relations.*
el renglón, *the line.*
la ganància, *the profit, gain.*
la plàza, *the market, place* or *town.*
avisàr, *to advise* (not *to counsel*).
aconsejàr, *to advise* (to *give counsel*).
el aviso, *the advice* (as of shipment, draft, etc.).
el consèjo, *the advice* (counsel).
preguntàr, *to ask, inquire* (not to beg or ask for).
sentir, *to feel, to be sorry.*
el àlma (f.), *the soul.*
perdèr, *to lose.*
el favòr, *the favour.*
quedàr, *to remain, to be* (thankful, etc.).
agradecìdo, *thankful, grateful, obliged.*
la gàna, *the inclination desire.*
de buèna gàna, *with pleasure, willingly.*
àlgo, *anything.*
el extràcto, *the extract.*
contàr, *to relate, narrate.*
la istòria, *the story, history.*
lo posìble, *their* (*my*, etc.) *best.*
la vuèlta, *the turn, return.*
á vuèlta de corrèo, *by return of post.*
baràto, *cheap, cheaply.*
pòrque, *because.*
¿ por qué ?, ¿ Porqué ? *why ?*

Exercise 11

Translate into English :—

1. ¡ Còmpre V. tòdas las pièzas en la plàza ! 2. ¡ No vèndan Vs. nàda por el momènto ! 3. Cuàndo mandèmos los bùltos, lo avisarèmos á Vs. 4. ¡ Comprèmos más máquinas ! 5. ¡ No vèndan (èllos) nàda sin nuèstro aviso ! 6. Yo desearía (deseàra) sabèr ùna còsa. 7. ¡ Dígame V. si ha recibìdo mi càrta ! 8. Si quisièsen (quisièran) hacèrlo, lo harían (hacèr). 9. (El) nos pregùnta si (whether) querèmos entràr en relaciònes comerciàles con él. 10. ¿ Cuándo me escribirá V. ? (¿ Cuándo ? like other interrogative words, takes the acute accent, when in a question). 11. Escribiré cuàndo yo tènga el tièmpo pàra hacèrlo (so). 12. Yo sentiría en el alma (exceedingly) si (èllos) perdièsen mùcho dinèro. 13. Si V. quisièse (quisièra) hacèrme èste favòr, le quedaría muy agradecìdo. 14. Cuàndo nos envíen la remèsa, les expedirèmos las mercancías.

Exercise 12

Translate into Spanish :—

1. When you sell the grey cloth, let me know (tell me) the price. 2. Do not sell anything at less than fivepence per (= the) yard. 3. If you wished (Impf. and Cond. Subj.) to sell that lot, I should buy it. 4. When they have (the) time, they will send us an extract of our account. 5. We wish you to tell us the truth (translate: that you tell—Subj.). 6. I wish to relate to you the whole (all the) story. 7. They would like (querèr—two ways: Cond. Indic. and Cond. Subj.) to say a word to us. 8. Tell me it now, or tell (it) me never. 9. If you give them the order, they will do their best to execute it. 10. We wish to receive the pattern by return of post. 11. If he bought so cheaply, he would make a profit of 10 per cent. 12. Do not say so, because it is not true.

Key to Exercise 3

1. We should not have returned the goods to you. 2. Will you have seen the customers in the warehouse ? 3. They had studied the lesson. 4. What should we have put on the table ? 5. I shall have sent the letters by the same mail. 6. By ordering the goods to-morrow we shall receive them next week. 7. What would you have done in my place ? 8. The partner had died much sooner. 9. Already they had written about this matter (subject). 10. He would have followed the instructions prescribed in the order note. 11. You will have provided their friends with all the necessary funds. 12. We shall put the goods in a separate room. 13. My representative will put the matter in the hands of a lawyer. 14. They would have put that man in my place. 15. When we had said all, there was no more time to catch the train. 16. Though you were able to pay the account, you have not done so (it). 17. Feeling (regretting) greatly the loss of this good customer, they would have made any sacrifice in order to serve him and receive his orders. 18. Having said this, the salesman has offered me the prints at a very low price. 19. We should have seen first whether it was worth the trouble. 20. By saying this you would offend the representative of the house much. 21. When you have sent the goods, we shall write to them. 22. If he had done this, he would have written to us.

Key to Exercise 4

1. Vinièndo tempràno, Vs. han vìsto al nuèvo clièntе. 2. El tren hubièra llegàdo más tempràno, àntes de las nuève. 3. Yo habría hècho mi lección. 4. Habrá puèsto la luz eléctrica en los despàchos. 5. Vs. habían pagàdo el dinèro al cajèro del negociànte. 6. ¿ Sàben Vs. si el compradòr del clièntе había cubièrto las muèstras àntes de salìr ? 7. ¿Porqué no habría llegàdo nuèstro viajànte más tempràno ? 8. No habíamos vìsto las muèstras que Vs. habían entregàdo á nuèstro viajànte. 9. El bùlto habría llegàdo ròto. 10. Habrán vuèlto àntes de la llegàda de los viajàntes. 11. Habré abièrto los bùltos y los fàrdos. 12. Murièndo tan jòven, no habrá dejàdo bastànte fòndos pàra hacèr el negòcio. 13. ¿ Habré recibìdo la càrta àntes de llegàr mañàna por la mañàna ? 14. ¿Había muèrto el jèfe de la càsa àntes de mi llegàda en èsta ciudàd ? 15. Habríamos vìsto á V. en el almacén, si V. hubièse llegàdo más tempràno. 16. Yo habría hablàdo con V. sòbre (en) èste asùnto, si V. hubièse llegàdo àntes de las nuève. 17. Habrían entregàdo los géneros, si V. hubièse (hubièra) pagàdo la cuènta. 18. El estampadòr habría imprèso las circulàres, si hubièse recibìdo el papèl. 19. Habríamos hablàdo á Vs. si hubièsemos podìdo ver á Vs. 20. ¿ Qué habría dicho V., si hubiésemos vuèlto ayèr ? 21. Cuàndo han vuèlto Vs., vèngan á la càsa. 22. Habríamos vìsto al giradòr del gìro, si no lo hubiésemos recibìdo hoy. 23. Si la lètra no es pagàda al vencimiènto, la mandarèmos protestàr. 24. Cuàndo hàyan (pres. subj.) expedìdo los géneros, girarán un gìro sòbre nuèstra càsa. 25. Las fìrmas de los giradòres, los endosàntes y los endosàdos son bièn conocìdas.

A. C.

Continued from page 103.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).

ASIA.—III

PROCEEDING round the continent we now come to the eastern drainage system, which coincides for all practical purposes with the Chinese Republic. The drainage of this region consists, besides the Amur, which has already been defined, of the rivers flowing into the Pacific, chief among which are the Hoang Ho and Yang Tse Kiang. But besides these there are some internal drainage systems, the greatest of which is that of the Tarim, flowing into Lob Nor, which drains Chinese Turkestan, and the Ili, flowing westward into Lake Balkash.

Rivers of China

The Tarim has for its head streams many tributaries, which flow from the slopes of the Tian Shan, Karakoram and Kuen Lun and are collected by the main stream, which after a course still not satisfactorily explored ends in the western extremity of Lob Nor. This lake, which like others of the central Asiatic lakes is shrinking in size, is about 80 miles long by ten miles broad, and is a shallow sheet of fresh water. The Tarim basin forms the western portion of the central Asiatic plateau and has an area of about 500,000 square miles. It is surrounded by a magnificent rampart of lofty mountains arranged in the shape of a horseshoe and generally about 20,000 feet high, having peaks rising to 28,000 feet. Towards the east the approach is open.

Most of the basin consists of rolling plains of sand traversed by various streams, along whose banks is a dense growth of vegetation. But for the most part the region is inhospitable. Minerals are abundant, especially in the neighbourhood of the Kuen Lun slopes, but except for gold little is produced.

The Hoang Ho and the Yang Tse together drain an area of nearly 1,500,000 square miles and have their sources in the heart of the central plateaux.

The Hoang Ho, or Yellow River, has a remarkably circuitous course of 2,500 miles long which has varied considerably even in recent years. Soon after its source it flows N.E. and E. and then sweeps round to the W. and N. through the Burkhan-Buddha range; thence its course is N.E. when it circles the Ordos desert and passes southward through a gorge separating the provinces of Shan Se and Shen Se. Farther on it turns at right angles towards the East, and from Kai-feng now flows N.E. to the sea in the Gulf of Pe-chi-li. Before the year 1852 and for 600 years previously, its course from Kai-feng was south-east, entering the Yellow Sea some 300 miles to the south of its present mouth. But in the thirteenth century its course was almost identical with that which it takes to-day.

Yang Tse Kiang

The Yang Tse Kiang has a no less winding course than that of the Hoang Ho. At its source the two streams are separated by a narrow watershed only, and at their mouths they have mingled their waters in a common delta below Nankin. But the Yang Tse takes a southerly course in its upper parts, so that at its most southerly portion it is actually 1,000 miles from the Hoang Ho where it sweeps round the Ordos desert.

The length of the Yang Tse is about 2,800 miles, though the distance from its source to its mouth is only about 1,800 miles in a straight line. Some idea of the wanderings of its course will be obtained from these figures.

The basin of the Yang Tse Kiang comprises over one half of China proper and consists of some of the richest land in the globe, with illimitable resources of every kind, including vast coal-fields. The main stream and its tributaries are crowded with shipping, and the tides of the sea run inland for over 200 miles.

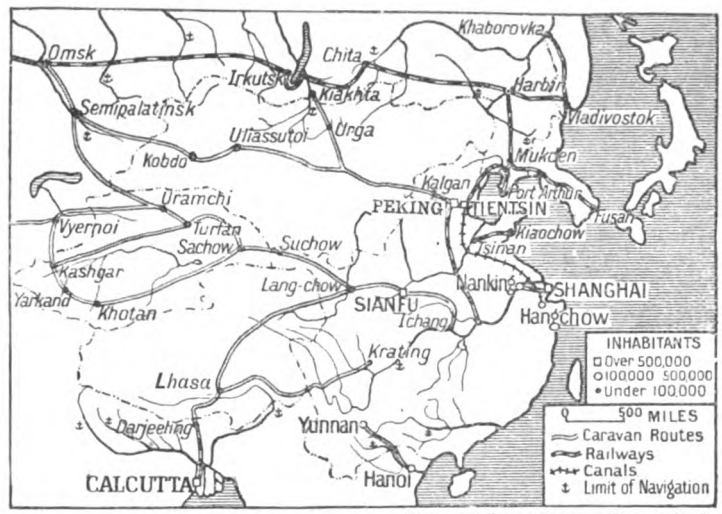
The Pei Ho river basin is important not so much by reason of its size as because in it is

situated Pekin, the Chinese capital. The many streams of this basin unite at Tien Tsin and flow down to the gulf of Pe-chi-li. The whole basin is subject to disastrous floods over an area of 6,000 square miles, which are caused by the swollen waters of the head rivers being unable to find room to reach the sea through the common channel below Tien Tsin.

Besides the numerous lakes along the Yang Tse Kiang banks there are many, mostly of small size, in Tibet. Most of these are fresh, but one, the Bul-tso, or Borax Lake, used to furnish the so-called "Venetian" borax.

The Chinese Republic may be considered as divided into four parts: Tibet and Chinese Turkestan on the west and Mongolia and China proper on the east, Mongolia lying to the north of China proper, China proper being the largest and most populous.

Tibet, which is under Chinese suzerainty, is governed by the Grand Lama, who has his capital at Lhassa. It forms the loftiest plateau in the globe, at no point being less than 11,000 feet above the sea. The northern part consists mostly of mountain ranges and is practically uninhabitable during the greater part of the year; the southern portion, somewhat lower and traversed by the Brahmapootra River, contains most of the population. The Tibetans are of the Mongolic group and their industries are few, consisting of the export of gold, wool, salt, skins, ponies, etc. Their imports from China proper are tea, silks, porcelain, leather and cotton goods, etc.



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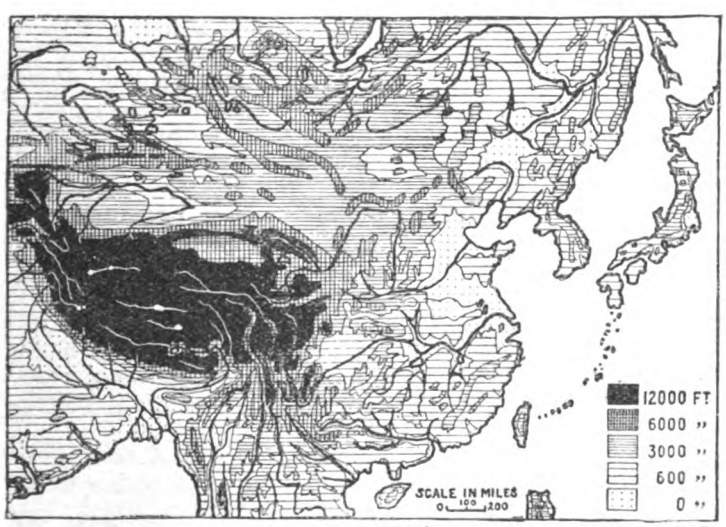
COMMUNICATIONS OF CHINA.



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OROGRAPHICAL MAP OF CHINA.

Chinese Turkestan consists almost entirely of the Tarim basin. It is largely desert, the population lying chiefly along the western edges. This district produces cereals, cotton, tobacco, opium and fruit, and has considerable mineral wealth of gold, lead and coal. Jade is also a well-known product of the Khotan district. The population is about 3,000,000, mostly of Turkish stock.

Mongolia: the north-western portions of this region are mostly mountainous, the central stony and sandy desert developing into grassy steppes, called the Gobi. The south-east portion forms a transition between this and the fertile districts of Manchuria and China proper.

Generally speaking, the climate is not unhealthy, though it is of an extreme continental type. The chief occupation of the Mongols is the tending of their herds of

oxen, sheep, camels, etc., which constitute their chief wealth. The mineral products have been but little worked, but industries are growing with development of communications.

Korea (Japanese *Chōsen*), the still little-known and mountainous peninsula of Eastern Asia, now belongs to Japan, whose people have greatly developed its agricultural and mineral resources. The influence of Chinese civilisation is still marked, however.

The capital is Seoul, which is connected by a railway with the sea at Chemulpo, and there are now other lines both in operation and under construction. The chief exports are ginseng (a medicinal plant used as a stimulant), rice, silk, and cattle, besides gold and other minerals. Lately cotton has been grown on a large scale.

Trade and Commerce

Excepting the large stretch of territory along the lower regions of the two great rivers, the Hoang Ho and the Yang Tse Kiang, and generally for a lowland belt along the sea, China proper is a country of mountainous character.

Though the mountain ranges have not the elevation of the central Asiatic plateau, of which they may be considered to be offshoots, they are nevertheless of considerable altitude.

The chief industry of China is undoubtedly agriculture, and as the soil is wellnigh inexhaustibly fertile, its productiveness is enormous; this is increased by the industry and ingenuity of the patient and industrious race that inhabits it. In the north are grown cereals, beans, tobacco, cotton, hemp and fruits of all kinds. The chief rice-growing and most-populated districts are in the centre.

In the south the bamboo and the tea shrub, together with rice, wheat, sweet potato, cotton and various fruits, are grown. On the slopes of the western hills the opium poppy is (or was) cultivated, though the production of this drug is now severely restricted. Although forests are rare in China, evergreens, flowering shrubs and resinous plants grow in great profusion, the products of tropical districts often occurring side by side with those more characteristic of temperate climates.

In the southern districts the mulberry tree is extensively cultivated, the leaves of which are the natural food of the moth Bombyx mori, which is commercially most valuable for producing silk.

Silk is one of the chief industries of China, and over a quarter of the entire world's production of raw silk derives from the country. Tea and cotton are other important industries, and the porcelain trade has its centre in Kiang-si and in Kwang-tung.

Cattle, sheep and horses are not common in China, the principal animals being buffaloes and swine. Ducks are very largely reared, and these, with fish, rice and vegetables, form the chief articles of food.

China is enormously rich in minerals; coal, gold, silver, iron and quicksilver are largely distributed, but much of this mineral wealth is unfavourably situated far from the sea.

The population of China has been variously estimated between 400,000,000 and 500,000,000—the most popular religion is the Buddhist, though there are 30,000,000 of Mohammedans in the country.

As regards climate, China enjoys a more copious rainfall and more regular seasons than central Europe, but the mean average rainfall and temperature are about the same. The characteristic typhoon is caused by the meeting of the South-west and South-east Trades, which meet in the Pacific near the coast. They occur regularly in summer along the coast to the south of the Yang Tse Kiang.

China's Great Wall

The capital of China is Pekin, and there are probably at least 100 cities with a population of over 100,000 inhabitants. From the point of view of commerce the most important cities are the "treaty ports," of which Shanghai and Canton are the best known.

Excluding the Russian and Japanese systems of Manchuria, there are now over 3,000 miles of railway open in China, while many other lines are under construction. The other means of communication are the numerous roads, though generally badly kept, and a very extensive system of water communication by river and the well-developed canals.

In this necessarily very brief account of China mention must be made of the Great Wall, some 1,600 miles long, which was commenced over 300 years before the Christian Era as a defence against the Hiung-nu. It is built of earth and pebbles faced with brick, and is from 15 to 30 feet high and 15 feet wide at the top. At intervals of about 200 yards there are towers 40 feet high. The Great Wall runs, roughly, along the boundary between China proper and Mongolia.

C. J. S.

Drawn by A. Hugh Fisher.

WILD ANIMALS OF TIBET.

The mysterious, forbidden land which occupies the loftiest plateau in the world, a plateau at no point less than 11,000 feet above the sea.

Continued from page 109.

MATHEMATICS:

Contributor : — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

MECHANICS.—X

58. Composition of Forces

We have seen that forces have both magnitude and direction, for Newton's second law states that change of momentum is equal to the impulse which produces it and is in the same direction. Since the impulse is the product of force and time, if we consider unit mass, we may measure the magnitude of the force by the velocity imparted to unit mass in unit time. Hence a force may be represented by a straight line in magnitude and direction, this straight line being drawn in the required direction and being proportional in length to the velocity imparted by the force to unit mass in unit time.

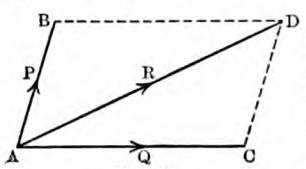


Fig. 32.

Further, in order completely to define a force we must state its point of application, and the straight line representing that force must be drawn to the point of application.

When a body, instead of starting from rest, is moving in a direction different from that of the impressed force, in order to find the resultant velocity we must compound the velocity due to the impressed force with the initial velocity.

When two or more forces act on a particle, each one tends to produce an acceleration in the direction in which it is applied. The particle, however, unable to move in several directions at the same time, will move with a certain acceleration in a certain direction. Now this acceleration could have been imparted by a single force applied in that particular direction. Such a force is called the **resultant** of the original forces.*

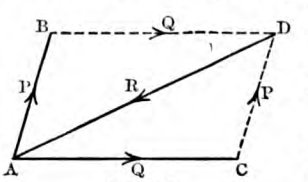


Fig. 33.

The action of reducing the various original forces to one resultant force is called the **composition** of forces.

When two or more forces are simultaneously impressed on a body, they are said to be **in equilibrium,** if they produce no change in the state of rest or of uniform motion of the body.

59. The Parallelogram of Forces

Since forces may be represented in magnitude and direction by straight lines, the Parallelogram Law clearly holds good for two forces acting simultaneously on the same particle.

Suppose two forces P and Q acting on a particle m are represented by the straight lines A B ; A C.

Then the length A B represents the magnitude of the velocity which P would impart to unit mass in unit time, and A B is drawn in the direction in which P acts. Similarly A C is drawn in the direction in which Q acts and the length A C represents the magnitude of the velocity which Q would impart to unit mass in unit time. The actual velocity acquired is the resultant of these two velocities, found by the Parallelogram Law, i.e. it is A D. Therefore A D shows the direction in which the **resultant force** R would act and the length A D represents the magnitude of the velocity which R would impart to unit mass in unit time. Thus A D completely represents the resultant R. Since $v = at$, and in the above we have taken the velocity imparted in unit time, $t = 1$ $\therefore$ $v = a$. That is to say, we may take the length of the lines to represent the magnitude of the accelerations produced by the forces. This was to be expected since we know that force is proportional to acceleration.

60. The Triangle and Polygon of Forces

It follows from the above that if three forces acting on a particle can be represented in magnitude and direction by the sides of a triangle, the forces will be in equilibrium. In this case the three forces are not all represented in *position* by the sides of the triangle.

Suppose P, Q, R are the three forces represented in magnitude, direction and position by A B, A C and D A.

If we compound P and Q the resultant will be R acting in the direction A D. Therefore since we have a third force R, equal in magnitude to the resultant, but acting in the opposite direction, viz. D A, the forces P, Q, R will not change the state of rest or of uniform motion of the particle at A, i.e. P, Q and R will be in equilibrium.

Now C D = A B and is parallel to A B, $\therefore$ C D, the third side of the triangle A C D represents P in magnitude and direction though not in position. Similarly these three forces in equilibrium may be represented by the triangle A B D.

* Forces acting on an extended body need not necessarily have a simple resultant.

It follows that any number of forces acting on a particle are in equilibrium if the lines representing them in magnitude and direction (though not in position) form a closed Polygon.

61. **The resolution of forces** may be performed in the same way as the resolution of velocities and accelerations.

Examples:—

(1) A pendulum consisting of a ball weighing 3 lb., suspended by a thread 2 yards long, swings to and fro through an angle of 60° on each side of the vertical. Draw a diagram showing the directions of the forces acting on the ball, and of their resultant, at one end and at the middle (lowest point) of its swing. (London Matric. Exam.)

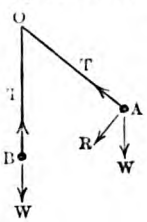


Fig. 34

When the ball is at A it is at rest for a moment and the forces acting on it are its weight W = 3 lb. acting vertically downwards and the tension T in the string acting along A O.

When the swing begins the ball starts to move in a direction perpendicular to O A. ∴ the resultant R of T and W acts along a line perpendicular to O A.

When the ball is at B the forces acting on it are its weight W = 3 lb. vertically downwards and the tension T of the string vertically upwards.

(2) Forces 1, 2, 3 and 4 lb. weight act towards the North, East, South and West respectively upon a body weighing 353·5 lb. Find their resultant and also the distance through which the body would move from rest in 25 seconds under the action of the forces. (London Matric. Exam.)

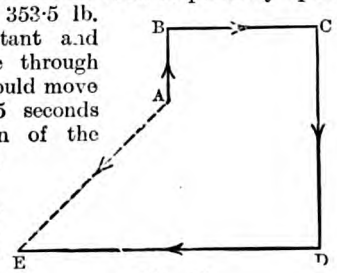


Fig. 35

(1) Draw a line A B 1 cm. long representing a force of 1 lb. weight acting towards the north. Draw B C, C D, D E respectively 2, 3 and 4 cms. long representing the forces acting east, south and west. Then A E represents the resultant. It acts south west and by measurement = 2·81 cm., i.e. represents a force of 2·81 lb. approximately.

(2) Alternative method. The resultant of a force of 1 lb. wt. due north and of one of 3 lb. wt. due south is a force of 2 lb. wt. due south. Similarly the resultant of the forces acting east and west is a force of 2 lb. wt. acting west. The final resultant therefore is a force of $2\sqrt{2}$ lb. wt. acting south west.

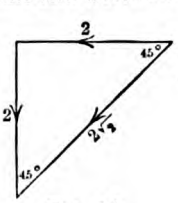


Fig. 36.

The acceleration due to the resultant $= \frac{F}{m} = \frac{2\sqrt{2} \times 32}{353{\cdot}5}$

$= {\cdot}256 \ \frac{\text{ft.}}{\text{sec.}^2}$

∴ distance moved in 25 sec., $s = \frac{1}{2} at^2$

$= \frac{1}{2} \cdot 256 \times 25^2 = 80$ ft.

Exercise 11

(1) Find the resultant of a force 10 lb. wt. and a force of 24 lb. wt. acting at rt. angles to each other.

(2) Find the resultant of 2 forces of 10 lb. wt. each acting at an angle of 60° to each other.

(3) What weight can be drawn up a smooth plane with a rise of 1 in 5, by a force equal to 200 lb. wt., acting up the plane?

(4) The horizontal and vertical components of a force are equal to weights of 5 grams and 12 grams respectively. What is the magnitude of the force?

(5) Two pith balls, each weighing 0·2 gram, are suspended from a point by 2 silk threads each 10 cm. long. After electrifying the balls by bringing a dry glass rod previously rubbed with silk into contact with them, and then removing it, they repel each other to such an extent that, when they are at rest, the angle between the theads is 60°. Represent upon a diagram the forces acting on the balls and determine their values.

Show that the angle between the threads must be bisected by the vertical through their point of suspension.

(6) A train of mass 200 tons travels with constant speed of 60 miles an hour in a northerly direction. It suddenly comes to a curve, on running over which for 10 seconds its motion has become deflected towards the east so that it makes an angle of 30° with the north. What eastward velocity has the train acquired by running round the curve, and what easterly momentum. What force must have been applied to give it this momentum, and how has the force been applied?

(7) A boat is towed straight along a canal by two horizontal ropes, one to each bank. One makes an angle of 60° and the other 30° with the line of the canal. The pull on the former is 100 lb. What is the pull on the latter?

(Questions 5, 6, 7 are from the London Matric. Exam.)

62. **Statics** is an important branch of Mechanics.

Under this heading we deal with the conditions under which several forces acting on a body or bodies are in **equilibrium**; i.e. the conditions under which the body, or bodies, remain at **rest** or continue in a state of **uniform motion.**

Now these forces are prevented by some form of resistance from producing motion; they generally occur as supporting a **weight,** either by **pressure** or by **pulling,** and they may therefore be conveniently measured in *gravitation units,* i.e. in pounds weight. Hence the statical **unit of force** is the weight of 1 pound, and is usually called a force of 1 lb. in the F. P. S. system, while the unit of force in the C. G. S. system is the weight of a gram or kilogram (1,000 grams).

Dynamically forces are said to be equal if, when acting on a body for equal intervals of time, they produce equal changes of velocity in the body.

Statically one force is said to equal another, if when both are applied to the same particle *in opposite directions,* the particle remains at rest or in a state of uniform motion.

Thus two forces are in equilibrium when they act in the same straight line through the same point, and are equal in magnitude but opposite in direction.

Any number of forces considered together is called a **system** of forces.

Now when a system of forces has a **resultant**

as defined dynamically on page 166, the system may be reduced to equilibrium by applying another force, equal in magnitude and opposite in direction to the resultant; such a force is called the **equilibriant.**

It then follows that if a system of forces is in equilibrium, each individual force is equal in magnitude and opposite in direction to the resultant of all the other forces.

Thus, to take an example, if A B be the resultant of a number of forces, B A is their equilibriant, and A B + B A = 0.

63. The Parallelogram of Forces.

Statically, forces may be represented by straight lines, as we represented them dynamically. Such a straight line must be *proportional in length to the magnitude of the force,* must be *drawn to the point of application of the force,* and must be *drawn in the direction* in which the force acts.

Clearly then the **parallelogram of forces** holds good statically, as well as dynamically.

Thus if two forces acting at a point be represented in magnitude and direction by the adjacent sides of a parallelogram, the resultant of these two forces will be represented in magnitude and direction by the

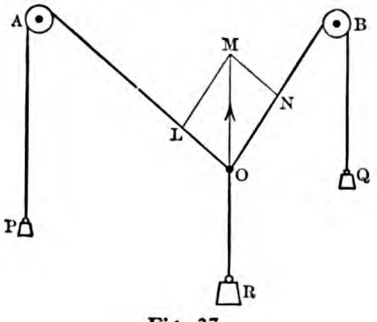


Fig. 37.

diagonal of the parallelogram passing through the point.

This may be verified experimentally in the following way:—

Two pulleys A and B are attached to the wall. To the ends of a thread passing over them both are attached weights P and Q, and to some point O, in the thread between the pulleys, a third weight R is attached.

When the threads have obviously assumed a position of equilibrium, measure on the wall, along O A, a straight line O L containing P units of length, and along O B a straight line O N containing Q units of length.

Complete the parallelogram O L M N and join O M.

Then it will be found that

(i) O M is vertical.

(ii) O M contains R units of length.

Now the point O of the thread is in equilibrium under the action of the weights P, Q, R pulling along the threads, therefore the resultant of P and Q must clearly be equal and opposite to the weight R.

Hence O M represents the resultant of the weights P and Q in magnitude and direction, and the weight R is the equilibriant of the weights P and Q.

Key to Exercise 10

(1) 4,800 foot-poundals or about 150 foot-pounds. (2) 1,080 ft. (3) (i) 32,000 foot-poundals; (ii) 10 kilogram-metres. (4) 3,500 foot-pounds. (5) 240. (6) About 3. (7) $322\frac{2}{3}$ tons weight. (8) $1\frac{5}{16}$ cwt. weight, 40 $\frac{\text{ft.}}{\text{sec.}}$. (9) 49,000 gramme-centimetres; 12,250 gramme-centimetres; zero. (10) 1; m : M.

M. A. L.

LOGARITHMS.—II

7. The following table of the logarithms of powers of 10 will be clear from what has gone before:—

Number	*Logarithms to the base* 10
$10^1 = 10$	1
$10^2 = 100$	2
$10^3 = 1{,}000$	3
$10^4 = 10{,}000$	4
$10^5 = 100{,}000$	5

and so on.

Now if, beginning with 10^1, we divide successively by 10, we get the following results:—

$10^1 = 10 \quad \therefore \quad 1 = \log 10$

$10^0 = 1 \quad \therefore \quad 0 = \log 1$

$10^{-1} = \frac{1}{10} = \cdot 1 \quad \therefore \quad -1 = \log \cdot 1$

$10^{-2} = \frac{1}{100} = \cdot 01 \quad \therefore \quad -2 = \log \cdot 01$

$10^{-3} = \frac{1}{1{,}000} = \cdot 001 \quad \therefore \quad -3 = \log \cdot 001$

$10^{-4} = \frac{1}{10{,}000} = \cdot 0001 \quad \therefore \quad -4 = \log \cdot 0001$

and so on.

It will be noted that we have written log 1, log ·001, etc., for $\log_{10} 1$, $\log_{10} \cdot 001$, etc. In common logarithms in which the base is 10, it is usual not to indicate the base at all; the student must understand that in every case where the base is not indicated the base actually used is 10. That is to say, log 4 stands for $\log_{10} 4$, log 5 stands for $\log_{10} 5$, and so on.

8. From the above tables we see that log 1 = 0 and log 10 = 1; hence the logarithms of all numbers greater than 1 and less than 10 must lie between 0 and 1. In other words, the logarithms of all numbers between 1 and 10 are positive proper fractions which, expressed as decimals, will clearly have no figure in the units place.

Again, since log 10 = 1 and log 100 = 2, the logarithms of all numbers greater than 10 and less than 100 must lie between 1 and 2. In other

words, these logarithms will consist of 1 + a positive proper fraction or decimal.

Similarly, the logarithms of numbers between 100 and 1,000 will consist of 2 + a decimal.

Proceeding in this way, we see that if a number has only 1 digit in its integral part, its logarithm will have no integral part, but will consist of a decimal only.

If a number has 2 digits in its integral part, its logarithm will have the integral digit 1.

If a number has 3 digits in its integral part, its logarithm will have the integral digit 2.

And in general the integral digit in the logarithm of a number is always less by unity than the number of digits in the integral part of the number.

Turning now to our table of logarithms to the base 10, on page 109, we may illustrate this by a few examples:—

Log 2 = ·3010; log 20 = 1·3010; log 2000 = 3·3010.

It is easy to see that this is correct, for log 20 = log (2 × 10) = log 2 + log 10 = ·3010 + 1 = 1·3010, and log 2000 = log (2 × 1000) = log 2 + log 10^3 = ·3010 + 3 = 3·3010.

Again, let us see what the logarithm of 252 will be.

Log 252 = log (9 × 7 × 4) = log 9 + log 7 + log 4 = ·9542 + ·8451 + ·6020 = 2·4013.

Here the integral part of the logarithm is 2, as we should expect from the rule established above.

Now, what are the logarithms of 25·2 and of 2·52?

$$\text{Log } 25{\cdot}2 = \log \frac{252}{10} = \log 252 - \log 10$$

$$= 2{\cdot}4013 - 1 = 1{\cdot}4013.$$

$$\text{Log } 2{\cdot}52 = \log \frac{252}{100} = \log 252 - \log 10^2$$

$$= 2{\cdot}4013 - 2 = {\cdot}4013.$$

Here again the rule holds good, and we note that as long as the digits remain the same and in the same order the decimal part of the logarithm is always the same, and the integral part varies with the position of the decimal point.

The **integral** part of a logarithm is called its **characteristic.**

The **decimal** part of a logarithm is called its **mantissa.**

9. It is clear from the second table on page 168 that **the logarithm of all proper fractions is negative.**

Let us find the logarithm of $\frac{3}{4}$, i.e. of ·75, by means of the table on page 109.

$$\text{Log } \frac{3}{4} = \log 3 - \log 4 = {\cdot}4771 - {\cdot}6020$$

$$= -{\cdot}1249.$$

However, it is more convenient to keep the decimal part of the logarithm, i.e. the mantissa, positive, and merely have the characteristic negative.

$-{\cdot}1249 = -1 + {\cdot}8751$, and this is written $\bar{1}{\cdot}8751$.

Thus, log ·75 = $\bar{1}$·875 to 3 decimal places (since we cannot be sure of the accuracy of the last figure).

Now consider the logarithm of 7·5.

$$\text{Log } 7{\cdot}5 = \log \frac{75}{10} = \log \frac{5^2 \times 3}{10} = \log 5^2 + \log 3$$

$$- \log 10 = 2 \log 5 + \log 3 - \log 10 = 1{\cdot}3978$$

+ ·4771 − 1 = ·8749 = ·875 to 3 decimal places.

Again, log 750 = log (7·5 × 100) = log 7·5 + log 10^2 = ·875 + 2 = 2·875.

$$\text{Further, log } {\cdot}0075 = \log \frac{{\cdot}75}{100} = \log {\cdot}75 - \log 10^2$$

$$= \bar{1}{\cdot}875 - 2 = -1 + {\cdot}875 - 2 = -3 + {\cdot}875$$

$= \bar{3}$·875.

Let us now tabulate these results and consider them:—

log 750	= 2·875
log 7·5	= ·875
log ·75	= $\bar{1}$·875
log ·0075	= $\bar{3}$·875.

We see that in each case the mantissa is the same, and that the characteristic varies with the position of the decimal point.

Thus, this rule which we found for integers also holds good for fractions, **since the mantissa is always positive.**

Hence, only the **mantissa** of logarithms are tabulated, and the **characteristics** may be found by inspection by the following easy rules:—

(1) If the number whose logarithm is sought contain one or more digits in the integral part, **the characteristic is positive and is always less by unity than the number of digits in the integral part of the number.**

(2) If the number whose logarithm is sought is wholly decimal, **its characteristic is negative and is greater by unity than the number of ciphers between the decimal point and the first significant figure.**

The above rules, however, only apply to common logarithms, i.e. to logarithms to the base 10.

Exercise 1

What are the characteristics of the logarithms of the following:—

(1) 35·467, 3546·7, 354·67, 3,546,700, ·35467, ·0035467.

(2) 1001001, 100·1001, 1001·001, 1·001001, ·00001001001?

10. In our next lesson we shall give a table of logarithms worked out to 4 places of decimals, and shall explain to the student how to use them. He will find them quite useful for many calculations, but where great accuracy is required 4 places of decimals do not suffice, and the student is recommended to consult Chambers's Mathematical Tables, in which he will find not only the logarithms of the natural numbers 1—108000 worked to 7 places of decimals, but also various trigonometrical, nautical, and other tables.

M. A. L.

Continued from page 112.

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

WATER-COLOUR DRAWING.—V

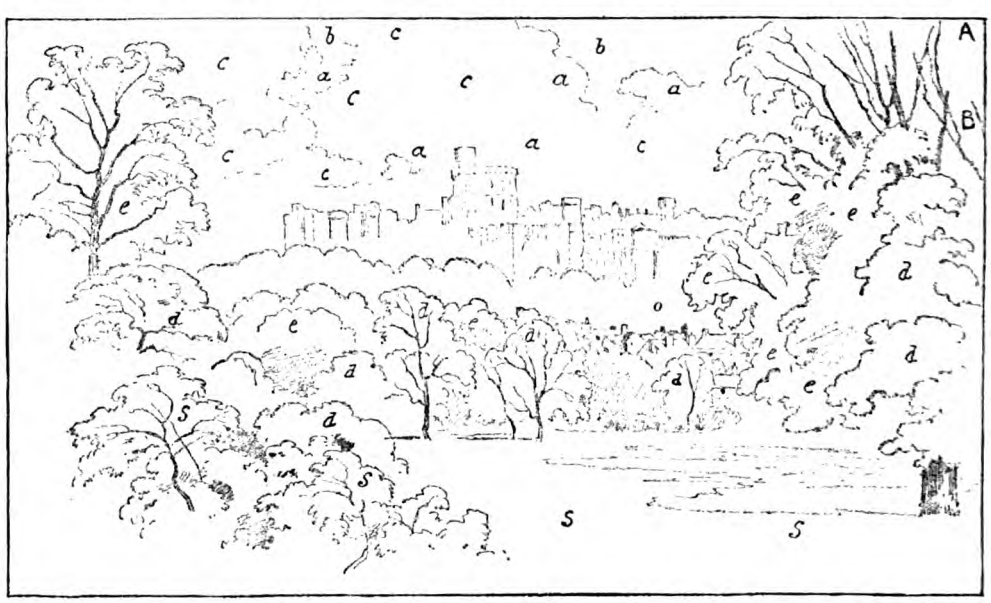
ALTHOUGH it is quite true that tones, and forms as well, become more vague and less easily defined as the eye runs back from the foreground to the middle distance, from the middle to the extreme distance, you cannot afford to be slipshod with your distances. The question of colour apart, you must learn the true significance of form, however vague and uncertain to the eye.

What the eye sees may be vague, but the *reality* is certain. There is a world of difference between vagueness and chaos.

The nearer an object is to you, that is to say, the closer it comes up to the foreground of the picture, the sharper will be its outline, the richer its colour, the more emphasised will be the details which form its component parts. And yet you have to bear in mind that the picture—foreground to distance and back again, must be a *whole*. Everything within its borders must unite to make a single, harmonious presentation to the eye of the observer.

As a practical instance and an exercise in learning the values of the three *diversions* of a picture (that is, foreground, middle and extreme distance), you may study the example on p. 171. This exercise should be tried first, at all events, in sepia. It is hardly necessary to add, for those who seriously *mean* to paint, that the most rigorous and consistent care should be taken to get the actual pencil drawing scrupulously correct in all particulars.

Upon this, after all, the whole result ultimately depends. Nevertheless, you should bear in mind that what matters is character—the character of the object you are delineating. Character can be rendered without microscopic detail. All you want to



WINDSOR CASTLE.

The initial pencil drawing calls for great care and accuracy.

give is the true relation of one form to another within the limits of the picture, and of one group of forms to the next group. Get the essentials right. Draw only what is necessary to the preservation of an object's particular individuality, and draw no more than that.

Only, let what you draw be accurate.

This true perception of characteristics will not come to the student in a day. It is a question of experience, and time only will teach you the last refinements of observation. But this is a quality that you can almost indefinitely exercise. Learn to watch everything with the painter's eye, whether it be cab-horses in motion, chimney pots upon the roof of the opposite house, the pattern of your carpet, or the high lights upon your beer jug. Notice, notice!—keep on noticing, and you will learn to remember and to notice still more.

To return to the drawing (p. 170), complete this so that you will not have to touch it with the pencil again. Next paint in the broad shadows on the trees. Do this carefully, leaving the middle tones and high lights. After it has dried, use the middle tint to tone down the lights which come between the middle tones and the more definitely dark ones. In painting the sky, use a light flat tint; and break off the edges of the clouds away from the light. When that is dry, put on your darker tint (it should only be very slightly darker) for the cloud shadows.

Remember the true meaning of "breaking off an edge." You do not wash it off altogether, but only in part. Some parts of the edge should be left quite sharp and clear; others melt off into shade and require to be softened down. That depends upon the brilliance of the light striking them. In doing this sepia exercise, remember the previous instances given for practice in the same medium.

Now take to your colours and study the sketch on p. 170 from the point of view not merely of gradations of tone, but also of various manifestations of colour. Notice the marks *a*, *b*, *c*, *d*, etc. You need not put these in your pencil copy, though in sketching, later on, it may be useful to make notes and figures on your actual drawing. But if you do this, remember to keep the marks so faint that while you can just distinguish them yourself, the first wash of paint will completely obscure them from the eye of an observer. In the present case use cobalt to begin with. Put a wash on the paper from A to B, over the part which subsequently will almost entirely be covered with trees. You will not spoil the colour of the trees by the use of the sky blue out of its limits of strict usefulness. The trees will be darker than the sky, and the blue will be hidden for that reason. Also, the trees are green, and blue is a component part of green. So that in this case the use of blue as a groundwork for the tree-foliage serves a definitely useful purpose.

However, wherever warm or light colours come in the tree, be careful to avoid the use of the cobalt blue which dims light tones and is prone to make warm colours, which pass over it, cool. Pass your blue again over the parts marked *b*. Where a shadow of a cloud comes in the blue the latter must be softened down a little.

WINDSOR CASTLE

as a study in sepia will afford the budding artist much valuable practice.

Now add a little sepia and just a touch of crimson lake to your cobalt, and with this work up the shadows of the clouds marked *c*. The nearer these shadows come towards the light, the more they should be broken. Away from the light they should only just be softened at their edges.

It often happens that you have to wait whilst paint is drying before you can touch your picture at all, and though you need not wait very long (the length of time naturally depends upon the amount of water in your wash), you can always fill up the meanwhile profitably, either by thinking out your scheme of colour or by drawing something else. In this present case, however, there is no occasion to wait; for whilst the sky is drying you can work a light tint of yellow ochre over the high lights on the trees without interfering with those parts of the picture which are still wet.

Choice of Colours

Notice that these high lights are marked *d*. Remember that the wash should be of quite a light tint. If the colour, when dry, is found not to be sufficiently intense, you can always add a little brilliance later on. But once you have put on too much colour you will find it exceedingly difficult, if not impossible, to reduce it without altering the character of the colour-scheme entirely. You can also put some of this yellow ochre on such parts of the foreground as are brilliantly lighted. Likely enough, if you are drawing a similar landscape from Nature you will see here and there warmer colours. These may be on the branches of some of the trees, or amongst dead leaves on the ground. A little burnt sienna may be mixed with the ochre to give this warmth.

The next step is to mix two tints to have ready by you in saucers, so that you will not have to stop and mix the second whilst the first is drying. Call these tints numbers 1 and 2. One should consist of a little brown pink mixed with indigo and crimson lake. The proportion to be quite accurate should be two of brown pink, two of indigo, and one of lake.

This tint will serve for the shadows and depths of the trees. No. 2 tint is cooler. Its component parts are the same as in No. 1. But you should put more indigo into it. It is the indigo which gives the sensation of coolness. You should have two brushes ready to your hand, one for each of the differing tints. First take No. 2 tint and paint those depths of the trees which are most remote from the light. These parts are marked *e* on p. 170. Then with your other brush dipped in No. 1 tint, mark the outer branches of the trees, which are closer to the light. The fact that these two slightly differing tints are laid on near each other wet, will make them harmonise agreeably, and produce a pleasing sense of "atmosphere" amongst the branches and foliage of the trees.

Now notice those parts marked *s* in the sketch. These are bright lights both on the ground and on the branches which stand out in the light. On these places you can put a touch or two of gamboge, which gives the necessary brilliance.

Now observe the space marked *o*. This is in the middle distance, and requires some kind of distinctive atmosphere which denotes that distance. This is best rendered by the use of cobalt with a touch of lake in it. This same tint will serve very well for the dark places of the houses you see in the glimpse of the town, and the shadows in the same quarter. Do this when the tree and foreground have been at least indicated, but before they are completely finished. Use the same grey as used in the clouds for the dark places in the castle, and for touching in such details there as are necessary—that is to say, the lines of windows here and there. Remember to place these details, such as they are, as accurately as possible. The lighter parts of the castle should be of yellow ochre. In this you can mix a very little raw umber, which will strengthen the effect. But on no account put in too much of this colour. The red bricks of the houses can be of Indian red.

There are gradations of tone to be noticed here, and you will find that unless you have made your picture on a fairly large scale this gradating process will be attended with considerable difficulty. In a very small space it is most troublesome to wash off the edge of a tint without interfering with the surrounding objects, trees, etc. Indian red goes excellently with cobalt and lake which have been mingled together in the shadows.

The extreme distance can be touched successfully with cobalt and lake as in the shadows. For shadows in this part of the picture you will also want grey. The best kind for this present purpose is a mixture of terre-verte and just a suggestion of crimson lake. Yellow ochre can also be employed to glaze over some of the more brilliant parts. But very little should be used.

Finishing Touches

Now it is time to come back to the front of the picture—the foreground and the trees. The masses of them should be gone over with terre-verte mixed with brown pink. Gamboge can be added for the brighter parts. You will find that the trees now have a flat appearance. But this can be remedied by picking out details with a touch here and there of brown pink and indigo.

Thus far you can go fairly safely according to rule; but it must be borne carefully in mind that you will see in ordinary everyday observation of colours many points which cannot be described here, and there is no sort of end to the variations of colour in the commonest and seemingly most unchangeable objects. You have to use your own discretion in mixing colours at the last, and depend upon your own instinct and perception when making up your mind what general colour-scheme to employ.

The above exercise should be regarded as no more than an exercise. If carefully followed out, it will at all events teach you the relative value of the colours employed and the order in which to tackle the various parts into which a picture may be subdivided.

J. G. B. L.

From "The World of Fashion," 1845.

EARLY VICTORIAN BONNETS.

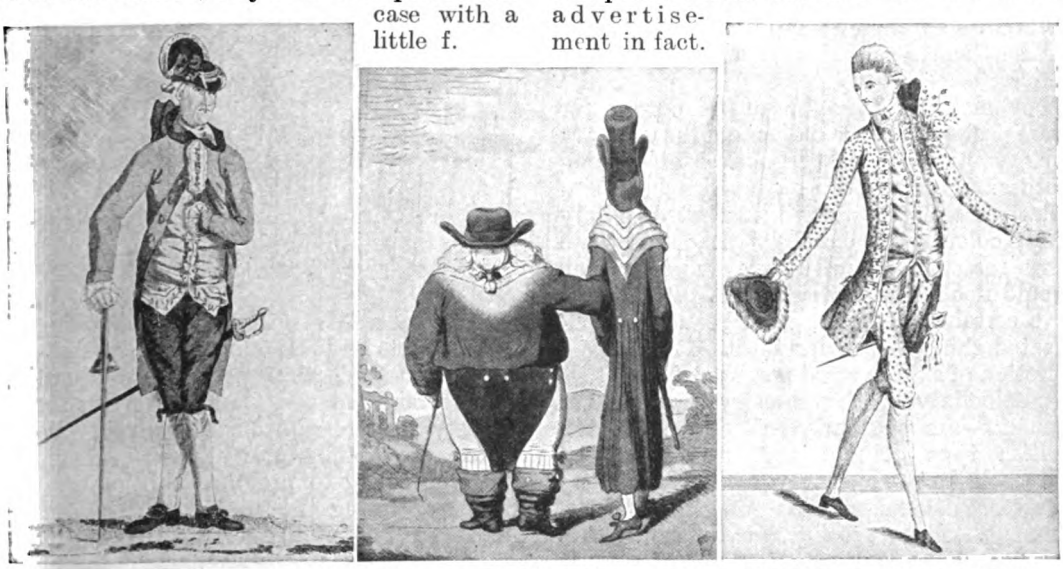
ART IN CLOTHING

THE amazing thing about fashion in dress is that more than in any other relation of life in which fashion plays a part, it always seems right—or if not always, very nearly so. The most highly individual woman (for it is of women's clothes that one must naturally speak first) obeys the fashion of the moment because she feels uncomfortable otherwise.

It is not that she is in the least afraid of being unlike the majority of people who obey fashion, but she suffers physical discomfort and, in a half-conscious measure, immense moral discomfort. But now and again we come across women who are professedly "arty" in their clothes, who conform to no fashion but that of their own little coterie. They complain of Fashion with a big F, and so fall completely under the sway of that which is just as much a fashion and a convention, only that it is spelt in this case with a little f.

If a woman of really genuine artistic perceptions wishes to express her own individuality in her clothes she does so through the prevailing fashion, bending it to her own especial requirements, but not breaking its essential rules. She wishes to escape notoriety, but she is not averse to discriminating notice. The slaves of the narrower convention court notoriety by being loudly remarkable.

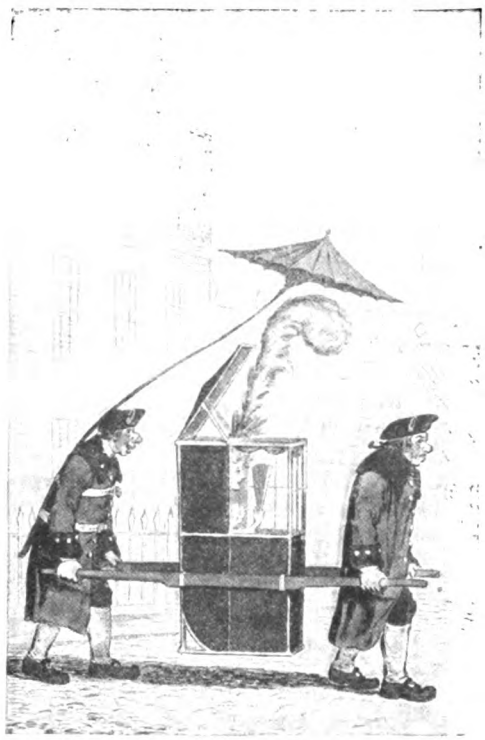
Men have done this in the past also—for the soundest of commercial reasons. They would walk in the most frequented streets dressed in plush breeches and carrying a large sunflower. This excited remark. One clubman to another, gazing from the windows to the street, would ask who the extraordinary person was. The answer would be "So-and-so, the poet"—or "the portrait painter," as the case might be. Then the first speaker would say, "I haven't read his poetry"—or "seen his pictures"—and proceed forthwith to do so. A first-rate advertisement in fact.



The Stableyard Macaroni, 1773. A Spencer and a Threadpaper, 1792. The Nosegay Macaroni, 1773.

EIGHTEENTH CENTURY ECCENTRICITIES OF FASHION.

No doubt—and this was surely a worthier motive—these and similar pranks were played for the fun of shocking stereotyped minds. But, seriously speaking, a man or a woman who is really original can mould a



A BELLE AT BATH.

As seen in her sedan chair by Gillray, 1796.

fashion and transform it in small details to please themselves without exciting undue notice.

For men there has been an outcry for years past against the dullness of the ordinary garb, particularly in the matter of evening clothes. And yet the outcry has been singularly misplaced. Provided that definitely dingy colours are carefully eschewed, there is no reason at all why usual male clothing should not look extremely well. It displays to a certain extent the most beautiful of all created things—a man's lines. It is only a question of skill in making. Evening clothes —particularly with breeches instead of trousers—are peculiarly well adapted to the British type of manhood, and even the billycock hat—so loudly and persistently abused by idealists—has much to recommend it. There are fine, bold curving lines about it. From an artistic point of view it is at any rate infinitely preferable to the "topper."

The point which it is so extremely hard to understand is how people of the early and mid-Victorian days could have endured the woman's costume of that date, the crinolines and so on. Of course, people say, "What would the folk of that date have said to our own modern dress?"—which at the time of writing is at the extreme opposite pole of form. But that is scarcely the point. The former hid and obscured and maltreated the lovely human form; the latter shows it to advantage. Therefore the latter is of the higher artistic value. Again, of course, the period in question was a notoriously bad one where art was concerned. But what causes these sudden upheavals in a whole nation's artistic perception? As a race we had good taste in 1800 and good taste in 1900.

"THE BIRD OF PARADISE."

A fantastic hat of about 1772.

What caused this waning and waxing of fine instincts? It is almost impossible to say, save that the period in question was devoted so very largely and so successfully to purely unromantic ends. When a race's best brains and highest endeavours are given solely to practical things—as was the case during the nineteenth century—there can be but little room in its inner consciousness for poetry and colour and things of the imagination.

J. G. B. L.

Continued from page 120.

BUSINESS AND COMMERCE:

Contributors **:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke) CHOOSING A CAREER (A. C. Marshall).**

COMMERCIAL TRAINING.—XXXI

In a retail business at all events good salesmanship must to a very considerable extent be fostered by advertising. The one is essentially an adjunct to the other. Advertising produces the people upon whom the arts of salesmanship are to be exercised.

There are two classes of advertising that affect the shopkeeper—the publicity set about by himself and that originating with the wholesalers and manufacturers. The former is naturally expensive, making a direct and concentrated appeal; the latter is far-reaching in its appeal, and to bring it to full fruition needs the co-operation of the shopkeeper.

Advertising Campaigns

To deal with the latter type of advertising first, we will imagine that some new breakfast food is to be placed upon the market. In order to ensure success, a huge advertisement campaign is planned with hoarding posters and space in the local newspapers. Commercial travellers set out to inform the retail trade of the coming boom; there are shop showcards and " liners " for the edges of the shelves. In some cases it may be arranged that there shall be practical exhibitions of the breakfast food, with free samples, shop-window displays, even a cook preparing dainty dishes.

This sort of thing costs the retailer not a penny. All he has to do is to go thoroughly into the question and to satisfy himself that the new food is likely to become a permanent feature of his trade. He must not be overwhelmed by the lavish display of advertisements and the promises of the promoters.

All the advertising has to be paid for eventually, and it is a safe axiom of advertising that in the end it is the consumer who pays the bill. There is no philanthropy in business; and when anything is given away it may be assuredly taken that something substantial is eventually to be expected in return.

However, we may assume that the retailer has personally sampled this new breakfast food and been satisfied. It compares favourably in price and quality with its opposing foods. The trade terms are good. The advertising campaign is thorough. All these matters being satisfactory, the retailer may well take up the commodity.

Seeing that a certain commodity is being given publicity he should reason matters out for himself on these lines:

This article is being greatly advertised; its name will be in the minds of the general public; if I were to display some of these goods on my counter the sight of them would strike a chord of memory with the customers and give practical application to the advertisement; if I were to send to the wholesalers for show-cards and advertising matter I should, by closely connecting the press publicity with the actual article to be sold, make many sales. In other words, I should myself benefit from this wide advertising for which I have paid nothing.

Local Publicity

Turning now to that publicity that is actually paid for direct by the retailer and which is almost entirely local in its appeal even greater care must be taken, for the tradesman's own money will be at stake and he must obtain the greatest possible value for every single penny he spends.

This type of advertising may be divided into two main classes. The first class is that which is intended merely to keep the name of the business itself before the public; the second class makes a direct and topical appeal concerning some article likely to be in demand at the moment. As examples of these two classes, we may read in the local railway time-table a standing advertisement of class 1:—

If You Want

Umbrellas, Sunshades
or Walking-Sticks,
go to

James Wilson, 21 Broad Walk.

On the other hand, in the local newspaper just prior to an important local event the following advertisement in class 2 might well appear :—

For the Fête and Gymkhana

Special New Sunshades in Stock.
All Colours and Prices.
See our New Art Shades
and Jade Handles.

James Wilson, 21 Broad Wall

It will be seen that whereas class 1 makes a permanent appeal, class 2 appeals for a particular time and occasion ; and the retail tradesman who would obtain the utmost from his advertising must pay careful attention to both classes.

Supply and Demand

As for the efficiency of class 1, it must be borne in mind that it is important to keep one's name before the public always. The one outstanding feature of all the wonderful publicity of Messrs. Pears is that it is designed mainly to keep the name of Pears' Soap before the public. In the same way, retailers must set their names permanently where the public will see them ; and, as a general rule, this class 1 advertisement is not expensive to maintain.

Class 2 is of course totally different, narrower in its appeal, more direct and topical. Also, it may be said, more expensive. The very first point about this class of advertising is to have something definite to offer, goods that are better or cheaper than those of one's opponents, goods that are wanted at the moment.

Putting the matter still more clearly, the tradesman possesses first of all a well-stocked business and he and his assistants represent all that goes to make up honest, clever salesmanship. He obtains some line of special and eloquent appeal and wisely advertises it, with the result that the general public is drawn to his premises. As a result, he is going to sell readily the particular goods he has advertised ; and, *in addition*, he is going to push his general stock and so reap a double reward. A. B.

CHOOSING A CAREER.—XXXV

The Scholastic Profession (*continued*).—In addition to the teachers who instruct the children of our public elementary schools in the ordinary subjects of general education there are at the larger schools teachers of cookery, laundry work, housewifery and other subjects of a domestic nature.

There are recognised training colleges for the teaching of these subjects, with examinations at the end of the courses and certificates for those who are proficient. Particulars of these special training colleges may be obtained from the *Board of Education, Whitehall, London, S.W.*1. There are naturally fees to be paid for this type of specialist education, the amounts varying at the different centres and ranging from five guineas per term upwards.

So far as salaries in the public elementary service go, they differ considerably with the local education authorities, and are, to some extent, dependent upon the size of the particular school and whether it is in a thickly populated area or in a rural district. Generally speaking, however, it may be said that the salary of male certificated teachers commences at about £160 per annum and may rise to £300, £400 or even more. The pay for women teachers is, as a rule, on a rather smaller scale.

All those who would wish still more closely to study the question of becoming teachers in this service should procure a copy of a handbook entitled, *How to Become a Teacher in a Public Elementary School.* It is a government publication, issued at the price of a few pence, and may be obtained through any bookseller or newsagent or from *His Majesty's Stationery Office, Imperial House, Kingsway, London, W.C.*2. A complete list of official publications of interest to those engaged in public education may be obtained by writing to the Secretary of the Board of Education.

In the ordinary course of events we come next to the secondary school, and in this class, broadly speaking, are included all schools between those of the public elementary type and the bigger public schools. The latter accept no government grants and retain their original status, as many of them have done for centuries.

The ranks of the masters and mistresses in *secondary schools* are filled almost entirely from those who possess University degrees ; and to a lesser extent from certificated teachers from the public elementary schools.

From the picture by E. M. Ward, R.A., in the South Kensington Museum.

CHARLES II. AND NELL GWYNN,

the beautiful favourite, once an orange seller at Drury Lane Theatre, who, having charmed the susceptible heart of the King, was installed in Pall Mall in a house with a garden running down to what now is the Mall. Evelyn has recorded in his *Diary* that he walked with the King "through St. James's Park to the garden where I both saw and heard a very familiar discourse between him and Mrs. Nellie . . she looking out of her garden on a terrace at the top of the wall, and the King standing on the green walk under it."

In former days it was customary to regard any person possessing a University degree as one fitted for the scholastic profession; but now the tendency is more and more not only to require the degree but also to demand that it shall be accompanied by proof of training as well as of education.

With this end in view, courses of training are now to be obtained not only at Oxford and Cambridge, but also at the newer Universities; and, throughout these courses, a point is made not only of theory but of practice as well. And, apart from degrees, there are other honours to be gained. There is the Cambridge Teachers' Diploma, for instance, and also the Board of Education's Certificate of Collegiate Training.

At all events, the man or woman with a degree, a high degree for preference, may be tolerably sure of making progress in the scholastic profession; and there is invariably a demand for the services of teachers with a science degree, with science forming so vital a part of present-day secondary education.

At the present time, the tendency of education is for boys and girls on leaving the public elementary school still to devote a certain part of their time (even though they may be working for a living) to the attainment of useful knowledge. This is arranged for by the provision of *Evening Continuation Classes;* and employers of young people are [illegible] to allow them the necessary time [illegible]g the year that they may attend these classes.

To some extent, the *Evening* Continuation Classes are conducted by masters and mistresses of public elementary schools, with a proportion of teachers from secondary schools; and this type of work, besides employing many more teachers, in some circumstances adds materially to the stipend of the teachers.

So far as *private schools* are concerned, they also offer considerable opportunity; but the worker with a University degree will progress farther and faster than one not so equipped. The usual plan is to commence as an assistant master or mistress, if possible tending rather to specialise in one group of subjects; and, from this point, one may obtain a headmastership and possibly the actual ownership of a private school eventually.

Such a school, in favourable circumstances, would yield a handsome return to a proprietor with a degree, and one possessing a knowledge not only of tuition but also of business principles. There are many risks, however, and the cost of conducting such a school is by no means low.

In the majority of cases it would probably be safer to purchase an existing school that was about to change hands rather than to venture one's capital upon an entirely new undertaking, except of course in exceptional circumstances. Practically the same remarks apply to *preparatory schools;* though there is a tendency now to send boys of tender years to small preparatory schools in healthful districts, where they may be trained for the large public schools. In such cases much depends upon the abilities of the headmaster's wife in catering for and looking after the domestic side of the establishment. The fees charged at such preparatory schools vary from £20 per term to £50.

So far as the public schools themselves are concerned, and some of the leading grammar schools, they are staffed almost entirely by men from the older Universities equipped with high degrees or else expensive specialist training. The educational standards for such posts are set very high; and the farther upwards one aspires in the scholastic scale the greater the demand for University attainments.

In other words, to gain appointments at the leading schools one must have passed through a public school oneself, and then have graduated with high honours at one of the older—and consequently more expensive—Universities.

It cannot be said, however, that the rates of remuneration at these patrician schools are very much better than those of the secondary schools, for the lower-grade men and assistant masters at all events, though the stipends in recent years have been notably advanced. At the same time, in both branches of the scholastic profession, there are very highly paid posts open to clever educationists who can obtain headmasterships.

As a matter of fact, in the case of the secondary schools, there pertains in some circumstances a system of capitation, the headmaster being paid a fixed salary, and receiving in addition to his dwelling-house a set sum per pupil trained.

In the same way, going to the topmost pinnacle of the profession, the professors and masters who teach in our *Universities*, be they the ancient or the more modern institutions, must be men who have graduated at one or other University with the greatest honours; and, in some cases, influence is called for as well.

And, as another outlet one must bear in mind the *Board of Education Inspectors*. There are Junior Inspectors; Assistant Inspectors; Inspectors; Divisional Inspectors and Chief Inspectors. The salaries vary from about £300 to £1,000 per annum.

Generally speaking, school inspectors are drawn almost entirely from the ranks of the teaching profession, for a personal knowledge of teaching is an important factor in the securing of an appointment.

University degrees are valuable to an applicant for a position as an inspector; and those who wish to apply for nomination should write to the *Secretary, Board of Education, Whitehall, London, S.W.*1, for a copy of the official form that has to be filled in. There is no educational examination to be passed, but a good deal of importance is attached to the medical test, as the work of a school inspector entails much travelling and is often arduous, whilst the hours of duty are long.

Taken broadly, the scholastic profession offers much scope to men and women who possess the necessary educational attainments, and who are also thoroughly adapted by nature and inclination to become tutors of the young.

Of recent years there has been a marked tendency in all parts of the country for the salaries of teachers of all classes to be raised, particularly as a minimum scale has been laid down by the Board of Education. This scale has materially affected the remuneration of teachers in remote rural parts. Certainly the demand for the services of male teachers, especially for the public elementary schools, has been far larger than the supply.

That this tendency will become even more pronounced with the extension of Evening Continuation Classes there can be little doubt. A resourceful teacher can do much to correct the bad effects of the decline in attendance towards the end of the session, and save his students and himself the irksomeness of going over the same ground again next session. A. C. M.

BOOK-KEEPING.—XXIX

THE student is now familiar with the principles of double entry, and it will require little consideration to grasp the keeping of accounts on the one entry principle.

Single Entry Accounts

We have seen that every business transaction has two effects, one a credit and the other a debit effect. Thus when goods are supplied to Thomas Jones the account of Thomas Jones is debited with the value whilst goods account is credited. If instead of considering these two aspects Thomas Jones is debited, and no further entry is made, we have a **single entry.** Similarly Thomas Jones is credited when he pays, and unless we make the corresponding debit entry we again make a single entry. Such a form of book-keeping would result in the **keeping of personal accounts only.** In the case of a payment by Thomas Jones, we should most probably obtain a double entry from the fact that the Cash Book would contain a debit entry. Hence we may have a mixed system of single and double entry. Either this or pure single entry is to be deprecated since

(1) We only get the single effect of transactions having a double effect.

(2) The books cannot be proved by taking out a trial balance.

(3) Single entry gives little information as to assets, except balances of debtors' accounts.

(4) No comparisons can be made, and therefore the various fluctuations in profits cannot be accounted for.

(5) Although a statement of affairs can be drawn up, it is not possible to prepare a balance sheet in the true sense.

The statement of affairs or of assets and liabilities, sometimes erroneously called a Balance Sheet, takes the form shown at the bottom of this page.

Suppose that at the end of the next financial year Mr. John Smith, seeing the

STATEMENT OF ASSETS AND LIABILITIES OF JOHN SMITH ON DEC. 31, 19..

	£	s.	d.		£	s.	d.
To creditors.. ..	12,000	–	–	By sundry debtors..	18,000	–	–
„ bills payable ..	1,200	–	–	„ bills receivable ..	4,000	–	–
„ bank	800	–	–	„ cash in hand ..	100	–	–
„ rent outstanding	100	–	–	„ stock	12,000	–	–
„ capital	20,600	–	–	„ fixtures and office fittings	600	–	–
	£34,700	–	–		£34,700	–	–

Drawn by Fred S. Howard.

SOME OF OXFORD'S FAMOUS COLLEGES.

error of his ways, desires to have his accounts presented on the double entry basis, and to adopt this system for the future. We find that during the year the following transactions have taken place :—

	£	s.	d.
Goods have been purchased to the amount of	15,000	–	–
Wages have been paid by cheque..	1,000	–	–
Creditors have been paid by cheque	24,000	–	–
Creditors' bills have been met at Bank	2,000	–	–
Cash paid into Bank as received from debtors	23,000	–	–
Debtors' bills are paid into Bank ..	5,000	–	–
Bills are drawn on customers ..	5,000	–	–
Goods are sold for	22,000	–	–
Drawings (John Smith)	500	–	–
Trade expenses paid by cheque	600	–	–
Rent and Rates paid by cheque ..	300	–	–
Discounts allowed	250	–	–
Acceptances	2,000	–	–
Bad Debts	200	–	–
Stock at December 31, 19.. ..	12,500	–	–

JOURNAL ENTRIES

19..				£	s.	d.	£	s.	d.
Jan.	1	Sundry Debtors	Dr.	18,000	–	–			
		Bills receivable	Dr.	4,000	–	–			
		Cash in hand	Dr.	100	–	–			
		Stock	Dr.	12,000	–	–			
		Fixtures and office fittings	Dr.	600	–	–			
		To sundry creditors					12,000	–	–
		,, bills payable					1,200	–	–
		,, Bank					800	–	–
		,, rent					100	–	–
		,, capital account					20,600	–	–
		Being statement of assets and liabilities on Jan. 1, 19..							
Dec.	31	Sundry debtors	Dr.	22,000	–	–			
		To sales account					22,000	–	–
		Bank	Dr.	23,000	–	–			
		Discount	Dr.	250	–	–			
		Bills receivable	Dr.	5,000	–	–			
19..									
Dec.	31	Bad debts..	Dr.	200	–	–			
		To sundry debtors					28,450	–	–
		Purchases Account	Dr.	15,000	–	–			
		To sundry creditors					15,000	–	–
		Sundry creditors	Dr.	26,000	–	–			
		To bills payable					2,000	–	–
		,, Bank					24,000	–	–
		Bills payable	Dr.	2,000	–	–			
		To Bank					2,000	–	–
		Rent and Rates..	Dr.	300	–	–			
		Wages	Dr.	1,000	–	–			
		Trade Expenses	Dr.	600	–	–			
		To Bank					1,900	–	–
		John Smith (drawings)	Dr.	500	–	–			
		To Bank					500	–	–
		Bank	Dr.	5,000	–	–			
		To bills receivable					5,000	–	–
		New stock	Dr.	12,500	–	–			
		To trading account					12,500	–	–

TRADING AND PROFIT AND LOSS ACCOUNT

Dr. FOR YEAR ENDED DEC. 31, 19.. *Cr.*

		£	s.	d.			£	s.	d.
Jan. 1	To Stock ..	12,000	–	–	Dec. 31	By Sales ..	22,000	–	–
Dec. 31	,, Purchases ..	15,000	–	–		,, Stock ..	12,500	–	–
	,, Profit and Loss Account (Gross profit) ..	7,500	–	–					
		£34,500	–	–			£34,500	–	–
Dec. 31	To Rent and Rates	200	–	–	Dec. 31	By Trading Account (Gross profit)..	7,500	–	–
	,, Discount ..	250	–	–					
	,, Trades Ex. ..	600	–	–					
	,, Bad Debts ..	200	–	–					
	,, Wages ..	1,000	–	–					
	,, Net Profit ..	5,250	–	–					
		£7,500	–	–			£7,500	–	–

BALANCE SHEET OF JOHN SMITH

As at Dec. 31, 19..

Liabilities	£	s.	d.	Assets	£	s.	d.
Sundry Creditors	1,000	–	–	Sundry Debtors	11,550	–	–
Bank	1,200	–	–	Bills Receivable	4,000	–	–
Bills Payable ..	1,200	–	–	Cash in hand ..	100	–	–
Capital 20,600				Stock	12,500	–	–
Less drawing 500				Office furniture, etc.	600	–	–
20,100							
Add profit 5,250							
	25,350	–	–				
	£28,750	–	–		£28,750	–	–

The Journal entries necessary to open the impersonal accounts and to inaugurate the double entry are shown on p. 180.

The Ledger accounts are opened, and the items are posted from the Journal. A Trading and Profit and Loss Account can be prepared (*see* bottom of p. 180) and a Balance Sheet framed (*see* above) when the Ledger accounts have been balanced.

Receipts and Payments Accounts

In some cases it is possible to keep accounts in a very elementary form, by using the Columnar Cash Book. Final accounts may then be presented in the form of a Receipts and Payments Account, which is a statement of cash transactions in the form of an analysed summary with receipts on the debit side and payments entered on the credit side.

It is in reality the personal account of the official who receives and pays the funds with the body on behalf of which receipts and payments are made, e.g. :—

JOHN BROWN, Treasurer,

In Account with the Trustees of the Zion Chapel, for Year Ended Dec. 31, 19..

19..	Receipts	£	s.	d.	19..	Payments	£	s.	d.
Jan. 1	To Balance in hand	171	11	1	Dec. 31	By Caretaker's Salary	72	14	6
19..	,, Pew Rents ..	88	4	4		,, Fuel	27	0	7
Dec. 31	,, Chapel Anniversary	11	15	10		,, Gas and Water ..	39	11	–
	,, Rent of Manse ..	24	–	–		,, Rates—Cottage..	1	6	10
	,, County Council for Fuel, Light, Cleaning, etc. ..	80	7	–		,, Insurance ..	4	18	9
						,, Printing	2	–	–
	,, District Council Rent	12	12	6		,, Ground Rent and Income Tax ..	14	–	1
	,, Sunday School ..	25	–	–		,, Organist's Salary	20	–	–
	,, Cottage Rent ..	5	14	9		,, Repairs	24	17	9
	,, Interest ..	2	5	5		,, Commission on Pew Rents, etc...	4	9	11
						,, House Tax, etc. ..	1	7	9
						,, Tuning Organ ..	5	–	–
						,, Chapel Yard ..	–	15	–
						,, Sundries	2	6	7
						,, Cleaning Materials	3	16	9
						,, New Linoleum—Vestry	2	7	6
						,, Choir (2 years)..	3	–	–
						,, Balance in hand c/d	191	17	11
		£421	10	11			£421	10	11
19.. Jan. 1	To Balance b/d ..	£191	17	11					

As the items of receipt and payment do not vary much from year to year, a specially ruled cash book can be used, so that the final totals of the analysis columns will give the items in the above account. All payments could not be provided for in the ruling, but the chief items could have special columns, others being grouped, and a simple analysis could be made, e.g. cleaning, cleaning materials, repairs, could be accommodated in one column. The subject of tabular book-keeping will be dealt with in a later lesson. It should be noted, however, that it is not a system of book-keeping as distinct from double entry.

treasurer with his Society, but in the form of a trading concern's Profit and Loss Account, the items of income being on the credit side and the items of expenditure being on the debit side of the account. A Balance Sheet is submitted, along with such Income and Expenditure Account. Care should be taken to distinguish capital and revenue expenditure.

Exercise

Work the following exercise :—

From the following Trial Balance prepare Income and Expenditure Account for the year 19.., and Balance Sheet as at December 31, 19...

THE FELLOWS UNION CLUB, LTD.

	£	s.	d.	£	s.	d.
Debentures, 3 per cent.				1,200	–	–
Furniture, Fittings, China, Glass, etc., etc., and cost of alterations to premises	1,750	6	2			
Stock in hand	307	4	–			
Sundry Creditors				1,386	18	–
Structural Alteration Fund				240	–	–
Salaries and Wages	1,250	16	10			
Rent, Rates and Taxes	522	–	8			
Printing, Stationery and Postage	51	16	6			
Fuel and Lighting	412	2	–			
Newspapers, etc.	57	17	10			
Repairs and Renewals	658	17	8			
General Household and Incidental Expenses..	373	3	4			
Interest on Debentures	36	–	–			
Provision for Structural Alterations	240	–	–			
Annual Subscriptions				1,753	–	–
Bank Interest				67	8	10
Profit from Billiards				834	4	4
Profit from Cards..				35	1	6
Profit from Provisions, Wines, Spirits, etc., etc.				1,330	19	10
Cash at Bank	2,502	7	6			
Life Membership Account				189	–	–
Accumulated Fund :—						
Balance January 1, 19..				1,126	–	–
	£8,162	12	6	£8,162	12	6

Income and Expenditure Accounts

Although receipts and payments accounts proper are confused with Income and Expenditure Accounts, they are totally unlike in method of compilation and presentation.

An **Income** and Expenditure Account is one showing the **whole** income accruing during the financial period under consideration, and the **whole** expenditure charged against such income, whether or not the income has been received or the dues been met. A Receipts and Payments Account shows cash actually received and moneys paid out, whether relating to the financial period or not.

The Income and Expenditure Account is presented not as the personal account of the

(London Association of Accountants.)

Note.—The item " Stock in hand " will doubtless include stock of stationery. This part of the item should be deducted from Stationery and Postage, as only the amount consumed should be charged to expenditure. In the example, as " Stock in hand " is not analysed, the whole of the item " Printing, Stationery and Postage " will be charged to Expenditure.

Life Membership Account is a liability in the Balance Sheet.

Key :—

Balance of Income over expenditure = £657 19s. 8d.

Balance Sheet Total = £4,799 17s. 8d.

F. H.

SHORTHAND.—XVIII

Key to Exercise 63

Messrs. Warren & Wilson,
Hardwick.

Dear-Sirs,

We-beg *to*-state *that-we-are* agents *for* various motor supplies, among-*which we-would* draw *your* attention *to-the* following—

Wakes & Weggs motor oils *and* greases *which-are* well-known *for-their* economy *for* wagons, lorries, etc.

Cornwall & Wareham's lamp sets *for* steel-tyred vehicles, *which-have-been* proved *by* experience *to-be-the* only reliable equipment *for* withstanding-*the* jolting *on-the* road. *Over two* million *are* now *in* use.

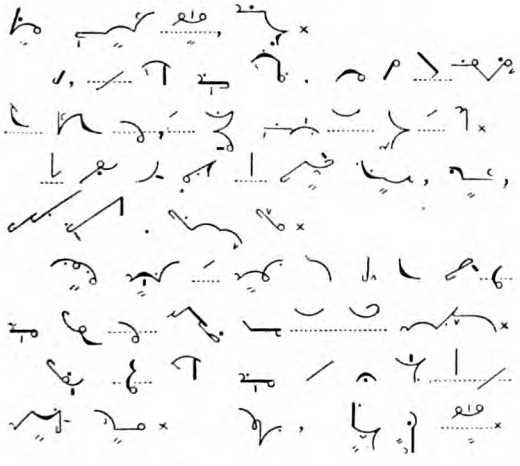
Charlesworth's solid rubber tyres *which-have-been* selected *by-the* French *for* war work.

We-enclose *a* copy *of-our* latest catalogue, *and shall-be*-pleased *to* answer *any* questions *you-may wish to* ask about *any of-our* lines.

Awaiting *your* further *pleasure*,

We-are,
Yours-truly,
Walker & Shadwell.

Key to Exercise 64



Prefixes.—A few of the common prefixes of the English language are represented by abbreviated forms, and these we have now to consider.

The prefix *com-* or *con-* initially is expressed by a light dot written immediately before the commencement of the following stroke; thus—

company, *congress*, *compress*,

connecting.

Such examples as *commit*, *commence*, *common* should be noted where the two *m's* or two *n's* are included in the dot.

In the following and a number of similar words better outlines are obtained by writing the prefixes in full:

commission, *consul*.

commiserate.

Medial *com-*, *con-*, *cum-*, or *cog-*, either in a word, or in a phrase, may be indicated by disjoining; thus—

incomplete, *inconsistent*, *circumvent*,

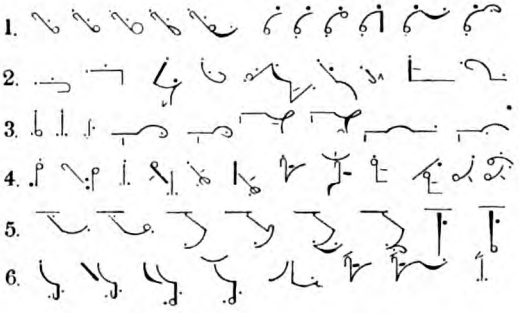
recognition, *they were compelled*.

Note that this method is not employed after a dot logogram, but it may be used after a dash logogram when this is written *upward*, as in *should commence*, *and conform*, but *date of the conflict*.

The prefix *accom-* is represented by a joined or disjoined *k*; thus—

accommodation, *accompanied*.

Exercise 65



Key to Exercise 65

1. press, compress, compresses, compressed, compressing, seal, conceal, conceals, concealed, concealing, concealment.
2. connection, connected, congenial, confession, conservatory, compare, compound, conductor, conflict.
3. commits, committee, committed, commission, commissioned, consul, consular, comic, comma.
4. conceit, preconceit, committee. sub-committee, composition, decomposition, control, uncontrolled, construct, reconstruct, conscious, semi-conscious.
5. accompany, accompanies, accomplish, accomplisher, accomplishing, accomplishment, accommodate, accommodates.
6. confident, *be* confident, *have* confidence, *in* confidence, *shall* continue, *and* control, *and* controlling, *on the* committee.

Enter-, inter- or *intro-* is expressed by a joined or disjoined *at* ; thus—

interferes, introduces, introspection.

Magna-, magne-, or *magni-* is expressed by a disjoined *m* ; thus—

magnanimous, magnetized, magnifies.

Trans- may be contracted by omitting the *n* ; thus—

translate, transfers, transmitter.

Where the inclusion of stroke *n* gives a facile outline, then the stroke is written ; thus—

transform, transaction.

Self- is represented by a disjoined circle *s* written close to the following stroke in the second vowel-place ; thus—

self-sacrifice ; self-com- or *self-con-* is indicated by a disjoined circle *s* written in the position of the *con* dot ; thus—

self-confidence, self-complacence.

Exercise 66

1.
2.
3.
4.
5.

Key to Exercise 66

1. entertain, entertained, entertains, entertaining, interchange, interchanges, interchanging, interference, interval, intervention.
2. interlink, interlock, intermarry, intermingle, introspect, intercommunicate, intermeddle, intermediate.
3. magnetizer, magnetizing, magnificence, magnificent, magnitude, magnify, magnanimity, magnanimous.
4. transmission, transmit, transmittance, transmitted, translator, transport, transportation, transparent, transpire.
5. self-possessed, self-righteous, self-love, self-reliant, self-command, self-congratulation, self-convicted, self-condemnation.

In- before is expressed by a small hook written in the same direction as the circle ; thus—

inspiration, instructor, inscriber, inhabit.

The stroke *n* is used when *in-* means *not*, as in *inhuman.*

Words beginning with the prefix *il, im, in, ir, un*, repeat the letters *l, m, n, r*, except where the prefixes *il* or *ir* may be expressed by the use of downward *l* or *r* ; thus—

mortal, immortal, material, immaterial, but *irrelevant, illimitable.*

Logograms, joined or disjoined, may be used as prefixes ; thus,

understood, outlook, cheerful, overlook, to-day, to-morrow, all-wise, almighty.

Exercise 67

GRAMMALOGUES

constitutional-ly ; selfish-ness ; inscribe-d ; inscription ; instruction ; instructive.

1.
2.
3.
4.
5.
6.
7.
8.

Exercise 68

1. consider, condemn, complain, incompetent.
2. interweave, magnifying, self-love, self-confidence.
3. translates, accomplishes, *over*turn, *sure*ly.
4. *We-shall-be-able-to inscribe-the instructive* passage *at a very*-low figure.
5. *Our* classes *are having instruction in-the constitutional* story *of-our* isles.
6. *The inscription on-the* tablet showed *the* explorer *was* free *from selfishness.*

Continued from Vol. IV., page 443.

ENGLISH LANGUAGE AND LITERATURE:

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PHILOSOPHY.—IX

In the dispute between materialism and spiritualism, it is tacitly assumed that matter and mind together form the sole contents of reality, and that there is an inherent antagonism between them. In the minds of scientists there has arisen a third entity called *energy* which is disposed to dispute the claims of both.

Ostwald defines energy as "work, all that can be obtained from work, and all that can be changed into work," and by work he understands "the expenditure of force required for the locomotion of physical bodies."

Energy: Stored and Actual

For example, two exactly similar trunks, one empty and the other full, are carried upstairs. It requires more work to carry up the full trunk than the empty one; hence the work done is proportional to the force exerted to overcome the weight and to the distance traversed. When both trunks are on the first landing, they possess more energy than when they were in the hall (the heavy one the more), and precisely that amount more which corresponds to the work done in lifting them to their new position. This added energy is called *potential* energy—stored up—but it may be changed into actual—or *kinetic*—energy at any time by moving the trunks over the edge of the first stair and thereby causing them to slide or topple down.

Innumerable experiments have demonstrated that in all such cases the potential energy of the raised object is equal to the work which was done in raising it, and is equal to the kinetic energy developed as the mass reverts to its original position. At any given moment in the flight downstairs the sum of the potential and kinetic energies is constant. A certain amount of additional energy had to be spent in bringing them over the first stair. This energy is always necessary to convert potential or stored up energy into actual energy. On the other hand no such excitatory or stimulatory energy is required to convert actual into potential energy. Whenever such transformations take place there is always a difference between the quantity of energy produced and that which was transformed, because some of the latter is always converted into heat, but the *total* energy before and after is constant.

Transformation of Energy

In all machines, energy is put in at one point and taken out at another. In the lever, pulley, wheel and axle, etc., work is put in and taken out; but in other kinds the energy is transformed into another kind or kinds of energy; e.g., in the dynamo, the work expended in rotating the armature is converted into electricity; in the electric motor, electricity is transformed into work.

Perhaps the most fundamental and most important of all energy transformation is that effected by the chlorophyll (green colouring matter) of plants which converts radiant energy (from the sun) into chemical energy.

Energy transformations take place only when some of it is "free" or "available." The potential energy of the water in a reservoir can only produce mechanical work when it is given a fall. A heat engine is capable of doing work only when there is a difference of temperature between the source and the sink. Electricity only becomes "available" when there is a fall of potential, and so on. Now all changes in the world around us are associated with the transference or transformation of energies, and as these are only possible when some of it is "free," it follows that free energy is the

indispensable condition of all phenomena. In machines, it has been indicated that in practice one form of energy is never entirely converted into another single form, and the reason of this is that another or other forms appear instead, but the better the machine the more complete is the transformation of one single form into another. The ratio of energy absorbed to useful energy produced is called the "efficiency" of the machine. A steam engine does not convert more than about $\frac{1}{7}$ of the potential (chemical) energy latent in the coal into useful work; its efficiency is about $\frac{1}{7}$. A plant leaf converts about $\frac{1}{100}$ part of the radiant energy it receives into chemical energy, and the efficiency of the human body is only about $\frac{1}{5}$. In all transformations much energy is converted into heat, and this energy is commonly spoken of as "lost" or "dissipated," because equalisation of temperature always ensues, and so the energy loses its freedom or availability. This tendency of all free energy to disappear (entropy) is everywhere operative.

Extinction of the Universe

If it be legitimate to argue about the universe, which may or may not be a closed system, its days are numbered. But that time of universal extinction when "the hour-hand of eternity will have completed one revolution," is so immeasurably distant that its consideration can have no practical bearing upon our life or philosophy. It may well be that the belief in a continuous future has a basis more real and more secure than that afforded by desire.

Since the law of the conservation of energy has been found to apply to all phenomena hitherto investigated, it is obvious that no philosophical theory must advance propositions which are at variance with it. If the view that all phenomena, physical and psychical, form, as it were, links in the same chain, the question arises, How do states of consciousness conform to the law? When light impinges upon the retina of the eye, the communicated energy is transmitted by the optic nerve to the brain where it produces the sensation of light. Thus energy is apparently transformed into consciousness, and if the latter is not of a physical nature the energy is apparently lost.

I prick my finger with a pin, the energy of the impact is conveyed by sensory nerves to the brain; this sends out a message through the motor nerves to my muscles which promptly withdraw my hand from the source of the pain. In all the physical changes here involved there is no reason to think that energy has been created or destroyed, but what of the feeling of pain? Again, I kick a football. Does the act of will to propel it involve an expenditure of energy? If "will" is not a form of energy, it apparently creates energy. By eliminating sensation and will from the physical sphere, in order to obviate the applicability of the laws of energy, we arrive at the position of psycho-physical parallelism. If we keep them within that sphere we must either admit that psycho-physical phenomena are exceptions to the law, or we must boldly affirm that consciousness is a form of energy. It is a physiological fact that every mental exertion involves an expenditure of energy. When we engage upon a piece of severe mental work such as balancing a refractory account, or solving a problem, the pressure of the blood in the arteries leading to the brain is immediately and appreciably increased. The well-known facts that mental application, unattended by any appreciable expenditure of energy in the form of external work, produces physical fatigue, and that the loss of energy and the tired feeling can be made good by the in-take of chemical energy in the form of food, clearly indicate the existence of a connection between mental activity and energy transformation.

Summary

Natural science cannot dispense with the concept of "energy," which is "work, and all that can be converted into and obtained from it." Energy is either actual or potential, and each can be converted into the other.

To convert potential into actual energy, a small, usually an exceedingly small, amount of stimulatory or excitatory energy is requisite (Law of Stimulus); but no such energy is needed to transform actual into potential energy.

All forms of energy (or all energies) are directly or indirectly transformable. Such transformation only takes place when some of the energy is "free" or "available." Since all changes, i.e. all phenomena, involve energy changes, "free" energy is the condition of all phenomena.

The "efficiency" of a machine is the ratio of energy converted by it into useful work to the amount of energy put into it. In all energy interchanges "free" energy is "lost" or dissipated as heat. Hence the tendency of the world is towards a state of equilibrium, of complete rest, of extinction.

All energy transformations take place in accordance with the law of the conservation of energy: "The sum total of energy in a closed system is constant."

The principle of interaction between matter and mind is brought into conformity with this law by admitting consciousness to be a form of energy.

E. H. T.

Continued from page 133.

HISTORY:

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BRITAIN'S STORY.—XVII

ALTHOUGH the Revolution Settlement necessarily dates from the events which brought it to pass, its seeds must be looked for in the Restoration of the Merry Monarch (1660), which was to revive in chastened England the halcyon days of peace, happiness and prosperity.

It were, however, as easy for the Ethiopian to change his skin or the leopard its spots, as for the Stuarts who succeeded the decapitated king to learn wisdom, practise justice, or do the right thing. What was bred in the bone could not help coming out in the flesh. The rich vein of human nature in Charles II. did, indeed, yield him some degree of popularity, and saved him from the fatal errors of his father.

The Merry Monarch

But the pride, folly, self-sufficiency, and duplicity which distinguished his race were latent in him all the same, and he could double the parts of the dissembler and the traitor with the facile *abandon* of an accomplished man of the world. Thus it came about that the insensate conduct of James II., during a reign of scarcely four years, only put the finishing touch to a prolonged and latterly intolerable contempt of Parliament and defiance of public opinion.

Regal absolutism was become the vogue of the seventeenth century. Yet the lot of its professors was the reverse of happy. It had cost Charles I. his head; Cromwell's masterfulness had aroused the bitterest hostility; to the Grand Monarch (Louis XIV. of France) it was both meat and drink, but he sickened of it ere the end; the Holy Roman Emperors cherished the will to be all-mighty but, to their salvation, let "I dare not" wait upon "I would"; only in the hands of the great Peter was it to make the life-blood course through the veins of Russia.

Even if his ambition to be in the fashion did not "ring true," Charles II. was as serious in his policy as it was possible for the lazy and nonchalant King to be; but when the second James, the slave of a fixed idea, infatuated with the single purpose of Romanising his country for his country's good, tried to "carry on the same old game," Englishmen called a halt and refused to be governed by a pinchbeck autocrat. Nevertheless, he was really far less dangerous than his brother, whose *bonhomie* was his best asset, since it covered a multitude of (political) sins, to say nothing of his insouciant conscience, his *auri sacra fames* and "poor Nelly."

Restoration and Reaction

As soon as the Parliament of 1661 got into its stride, it was evident that a period of reaction had set in. Its complexion was almost exclusively Royalist and Anglican, and its legislation—the Earl of Clarendon was Charles's chief counsellor—was coloured accordingly. The Press Act (1662) established a strict censorship and throttled criticism; the Act of Uniformity (1662), passed in order to bolster up the Roman Church, created Nonconformity, on the one part, and the Conventicle Act (1664) and Five Mile Act (1665) punished it on the other; while the repeal of the Triennial Act (1664) afforded the King a welcome opportunity of showing his hand. "He would," he said, "never suffer a Parliament to come together by the means prescribed in that Bill."

These measures may be cited as examples of the temper of Parliament and prove how ready both Houses were to relax their care of the common weal and to minister to the interests of Throne and Church.

Clarendon's honesty has never been questioned, but the situation demanded a wise, tolerant, and resolute statesman, broad-minded enough to understand and, at least

in part, to sympathise with the new ideas to which the momentous events of the Civil War and the Protectorate had given birth. Most of these qualities Edward Hyde did not possess, and his narrow, scrupulous regard for legality, coupled with excessive zeal as a Churchman, rendered him an incapable pilot of the State. But if he were a bad adviser for a monarch anxious to govern both constitutionally and progressively, he was the very man for a sovereign averse from control and inclined to " kick over the traces " on the smallest provocation.

The subserviency of Parliament did not, however, survive the fever-heat engendered by the Restoration. The Lords, indeed, were willing to support the King, but a different spirit began to animate the Commons. They gradually asserted their right to shape the national policy by assuming control of national expenditure. When faced with financial difficulties arising out of the Dutch war, they insisted (1665) that the supplies voted should be spent on the conduct of hostilities, and that the public accounts should be audited by commissioners expressly appointed.

For it was strongly suspected that much of the money granted for the service of the State was squandered on the pleasures of the King. Charles demurred to these demands on the ground that they invaded his prerogative, but he avoided a direct issue by proroguing Parliament—his favourite device to extricate himself out of tight places.

The Dutch in the Medway

But the gulf between the King and his Parliament was to become still wider. For a few months later (June, 1667) the disgraceful incident of de Ruyter's raid in the Medway inflamed feeling in the House of Commons. They demanded the immediate disbanding of the new forces, by which, it was already rumoured, the King intended to ensure his sway. Charles needed no prompting to selfish courses, and Clarendon, distrusted by the Commons, was dismissed as the supposed author of these and similarly sinister movements. To escape trial he withdrew to France, where he devoted his remaining years to his *History of the Rebellion.*

To gain his own ends Charles now affected to surrender, disbanding the forces, agreeing to an audit, and sanctioning an inquiry into the catastrophe at Chatham and the mismanagement of the war. Secretly, however, he determined to be served in future by ministers of his own choosing, to be king in fact as well as in name. He was able to foresee that this object would be unattainable unless he could find an additional paymaster. The Commons might be relied upon to vote supplies for public purposes, but he could not safely misappropriate these and, in any case, they would not suffice for all the needs of the programme he had mapped out in his mind. So he decided to avail himself of the willing assistance of Louis XIV., who knew his man and his price. It was the first and the last time that a concealed traitor sat upon the British throne.

Treaty of Dover

Though England was a party to the Triple Alliance (January 13, 1668) which had been entered into with Holland and Sweden to hold Louis in check, Charles was not deterred from playing fast and loose with the Powers concerned. John de Witt, the Dutch statesman with whom Sir William Temple had negotiated the treaty, according to the *Cambridge Modern History* (Vol. V., p. 201), " did not know that, at the very moment when Charles was proposing to Holland an offensive alliance against France, he was also proposing to France an alliance against Holland and Spain, and to Spain an alliance against France to the disadvantage of Holland." But all the time his heart was set upon some plan to use French gold and French arms to thrust Roman Catholicism on the English people and to enable him to pose as an absolute monarch.

These ends were to be effected by means of the Treaty of Dover (June 1, 1670), cleverly arranged by Charles's sister, the Duchess of Orleans, an innocent-seeming intermediary whose share in the transaction none was likely to suspect. This document stipulated, among other things, that Charles was to profess Roman Catholicism at the time he deemed most suitable ; that Louis was to furnish 6,000 men and £150,000 to crush any rising which the avowal might provoke ; that Charles was to assist in a war on Holland and contribute towards it 6,000 men (under a French general) and fifty ships (which, with thirty supplied by France, were to be commanded by the Duke of York), Louis bearing the whole expense and neither party consenting to a separate peace ; and that Louis was to pay Charles £250,000 a year during the war.

On these terms the King of Great Britain and Ireland agreed to become the pensioner of France ! No wonder this shameful instrument existed in two forms, one genuine and secret, the other false and for exhibition—the latter suppressing every reference to the

From the painting by E. M. Ward, R.A

JAMES II. RECEIVING THE NEWS OF THE LANDING OF THE PRINCE OF ORANGE (NOV. 5, 1688).

The Lord-in-Waiting who has brought the despatch is seen listening behind the screen, hoping to ascertain the course of events. The Queen is trying to rouse the perturbed but listless King to action, if not on his own behalf, on behalf of the young Prince of Wales. On the right of the King can be seen Judge Jeffreys, and the Papal Nuncio sitting by the screen.

Roman Catholic plot, lumping together all the moneys as costs of the war, and assigning to an English general the leadership of the united armies.

Charles's interest in Roman Catholicism had already been manifest. The Duke of York's conversion was known to him and he had privately intimated, the year before the Treaty, a wish to go over to Rome; but, unlike James, he did not choose to let all and sundry know that he contemplated a change of faith. He must approach the position carefully, by sap and mine, as it were. Hence he issued a Declaration of Indulgence on March 15, 1672, suspending the penal laws against all classes of Non-conformists and recusants—wide enough to embrace his co-religionists—and two days afterwards proclaimed war with Holland.

Titus Oates's Plot

Both steps were unpopular, and within a year the King was obliged to withdraw the Indulgence. By way of retort extra, the Commons, their *animus* whetted by Charles's own rash action, carried the Test Act (1673), which required every office-holder, civil or military, to take an oath denying the doctrine of Transubstantiation. This made it impossible for any Roman Catholic to serve the State, and the Duke of York at once resigned all his posts. The Commons being still restive, Charles had the effrontery to submit (January, 1674) the sham Dover Treaty to a joint committee of Parliament, with the gratuitous falsehood that it was the only treaty with France in existence. The Commons continuing sceptical, the King prorogued Parliament first to November and then to April, 1675, a quarterly allowance from Louis for the next two years enabling him to face the outlook with equanimity.

By now, however, one of the main provisions of the Dover Treaty had become a dead letter, and Charles was conscious that his dream of reigning as an absolute monarch over a Roman Catholic England would never be realised. Any lingering doubts he may have entertained were dispelled when he witnessed the outburst of fanaticism which attended Titus Oates's vamped up revelations of a Popish plot against the King and Protestantism. The Parliament elected in 1679 in succession to the Cavalier Parliament (which had sat for nearly eighteen years) was decidedly hostile, and Charles thought that if he allowed them latitude in things which were comparatively non-essential he might successfully cloak his purely personal aims.

But Protestant fervour was as hot as ever, and, to side-track the Bill which excluded the Duke of York from the throne, the King dissolved Parliament; though he was constrained, on the same day, to sanction the Habeas Corpus Act, which furnished stricter and prompter procedure in cases where the liberties established since Magna Charta might be endangered. His passionate desire was, of course, to throw out a measure which was as gall and wormwood to a despot, but dare not take such a step in view of his appeal to the people. Yet so cheaply did he hold even this tribunal that he almost immediately prorogued the new Parliament for a twelve-month. When finally the Commons met, they lost no time in passing the Exclusion Bill, which the Lords threw out by a substantial majority. The former retaliated by withholding supplies and the King rejoined with another dissolution (1681), summoning the next Parliament to meet at Oxford.

Charles was evidently making some progress with his lessons in absolutism and was now prepared to strike his final blow. Louis again befriended him, feeling that if he bought England's neutrality he would at least prevent her from co-operating with any other Power. Within a week of its assembling Parliament was dissolved and Charles never summoned another. Henceforth he should rule alone. One of his first objects was to destroy local self-government by forfeiting the charters of those cities and towns which had stood up for popular rights.

Death of Charles II.

It was necessary to subdue the Whiggery of London, which championed many a cause hated by the Court, and this he accomplished (1683) with the assistance of a renegade Lord Mayor, Sir William Pritchard, and a servile Bench. The Test Act was systematically disregarded and Dissent was punished with the utmost rigour of the law. Intrigue begat counter-intrigue, but the Whigs were checked at every move and mated by the discovery of the Rye House Plot (1683). And so the era of Chaos Redivivus seemed like to last.

Charles's days, however, were numbered. Struck down by apoplexy he passed away, with an apology for being "such an unconscionable time in dying," on February 6, 1685, after receiving extreme unction at the hands of Father Huddlestone. With the aid of French money the English King had enjoyed a short spell of absolutism, but had his life been prolonged he must either have been brought to reason or once again have left "on his travels."

James II. did not disappoint expectations. Tactless and a bigot, he made it his business to advance the cause of Roman Catholicism by example and precept in season and out. Mass was openly said at Whitehall and Dissenters were relentlessly persecuted. Monmouth's senseless rebellion, crushed at Sedgemoor on July 5 1685, was used as the pretext not only for the Bloody Assizes in which Judge Jeffreys won undying infamy, but also for the muster of 20,000 armed men on Hounslow Heath, illegally officered by Catholics. The encampment of so large a force within hail of the metropolis was an unequivocal defiance of the prevailing sentiment against a standing army. On the top of these incidents came the news of the Revocation of the Edict of Nantes and of the King's approval of that fatal step. The attitude of the Commons was ominous and, as if least said were soonest mended, James prorogued Parliament, which, as it happened, never met again during his reign, though not actually dissolved until July 2, 1687.

Apparently he considered he had a clear run ahead, for he now acted as if he were *supra leges*. He packed the Bench to obtain decisions in favour of Catholic appointments to office, the Test Act notwithstanding. He was at extraordinary pains to turn the Church and Universities against him. Instead of the healthy criticism of Parliament to guide or correct him, he gave ear to the counsels of confessors, sycophants, and time-servers. In return some of these, such as the Earl of Sunderland, did not scruple to betray him when they saw that the game was up and that he was plunging headlong to ruin.

Tyranny and Toleration

William Penn, whose father had been a naval friend of the King's, on his return from his newly founded State in America induced James to give tyranny a rest and try toleration. Accordingly on April 4, 1687, there appeared a Declaration of Indulgence, suspending penal laws in religious affairs, abolishing tests, and permitting to all freedom of public worship. The Dissenters, unready for so unblushing a *volte-face*, refused the proffered relief. They feared the Greeks, even when bearing gifts.

And they were right; for, almost contemporaneously with the issue of the Declaration, a mandate was sent to the Fellows of Magdalen College, Oxford, the terms of which constituted a flagrant piece of intolerance. It recommended them to elect as their President Anthony Farmer, a man of scandalous character, whose redeeming qualification in James's sight was that he was a convert to Rome, but who was legally unqualified, and on every other ground unfitted for the post. The Fellows elected John Hough, and out of the long and bitter controversy which ensued arose the strongest opposition which the Church of England had ever yet had the courage to offer to king or queen.

This was, indeed, highly significant and ought of itself to have opened James's eyes to the madness of his proceedings. By the new year (1688) the country was seething with discontent and men were instinctively looking to William, Prince of Orange, who had married the King's daughter Mary (1677), to deliver their country and secure the Protestant religion. The birth of a son to James by his second wife, Mary of Modena (June 10, 1688), ensured a Roman Catholic succession and, together with a deadly breach with the Anglican Church, precipitated one of the gravest crises in English history.

William of Orange

On May 4, 1688, James issued another Declaration of Indulgence, similar to the first, and ordered the clergy to read it from their pulpits on May 20 and 27. His presumption occasioned a complete rupture with the Church. Sancroft, Archbishop of Canterbury, and six bishops having respectfully protested that they could not be parties to the reading of the Declaration, the King had them prosecuted—*pour encourager les autres!* On June 30, amidst universal rejoicing, the seven bishops were acquitted.

On the same night seven representative Englishmen invited by letter the Prince of Orange to come over and safeguard the liberties and religion of their country. William was otherwise assured that the King, excepting such support as he might receive from Roman Catholics, stood absolutely alone; that Church, army, navy, and people were resolutely opposed to the further continuance of the reign of disorder which he and he only had created. The upshot is well known. The "Protestant breeze" locked up the English fleet in the Thames while it bore William's flotilla to Tor Bay, where he and his forces landed on November 5, 1688.

On December 9 the King sent the Queen and the baby Prince of Wales (afterwards the "Old Pretender") to France, and fled himself before daybreak on the 11th. He was captured near Sheerness and brought

back to London on the 16th. Flight, however, seemed to his fears the only way of safety, and a second attempt (which William wisely facilitated) was successful. On the 23rd of December James left his native land for good. Thereupon William undertook, by request, the executive administration until the Convention of the estates of the realm should settle the form of government.

On January 28, 1689 (six days after they had first met), the Commons resolved, without a division, that James "having endeavoured to subvert the constitution of the kingdom by breaking the original contract between king and people, and, by the advice of Jesuits and other wicked persons, having violated the fundamental laws, and having withdrawn himself out of the kingdom, had abdicated the government, and that the throne had thereby become vacant." In the most businesslike spirit the Lower House had in one day reached this decision, but when the resolution was sent up to the Lords much chopping of logic and splitting of hairs were indulged in. One party wanted a Regency; another wished that Mary should be chosen Queen regnant; a third urged that the throne should be filled by election.

A collision between the Houses appeared inevitable on the question whether the throne could be declared vacant or not. William, whose conduct had been unimpeachable ever since it was evident, months ago, that he might be called to the throne, now intervened, stating that he could not consent to be king consort. This announce-

From the picture by E. M. Ward, R.A.; Photo: Emery Walker, Ltd.

LADY ALICIA LISLE CONCEALING FUGITIVES AFTER THE BATTLE OF SEDGEMOOR,

where on July 5, 1685, Monmouth's senseless rebellion was crushed. Lady Lisle, the widow of one of Cromwell's Lords, was tried before Judge Jeffreys, found guilty of harbouring rebels, and executed at Winchester on September 2.

From the picture by E. M. Ward, R.A., in the Palace of Westminster; Photo: Emery Walker, Ltd.

THE ACQUITTAL OF THE SEVEN BISHOPS,

namely, the Archbishop of Canterbury and the Bishops of Bath and Wells, St. Asaph, Bristol, Chichester, Peterborough, and Ely, who for drawing up a protest against James II.'s Declaration of Indulgence were arrested and charged with publishing a seditious libel. Though tried before venal Judges and a packed Jury, the Bishops were acquitted (June 30, 1688) amid universal rejoicing.

ment brought members to their senses and it was unanimously agreed (February 6) to declare the Prince and Princess King and Queen, a vote which William accepted for Mary and himself. The Commons' supplementary resolution, passed on January 29, that it was not consistent with the welfare of a Protestant nation that it should be governed by "a Popish King" was adopted by the Upper House on the same day without debate.

Warned, by costly experience, that it was imperative to save the State from a repetition of such gross and wanton attacks as had taken place under James (and his brother), it was further decided (February 12) that the instrument calling the Prince and Princess to the throne should assert the fundamental principles of the constitution. Forthwith the famous Declaration of Rights was drafted and adopted.

After reciting the errors and crimes which had justified the Revolution, and recording that their author had abdicated the throne and that, under God, the Prince of Orange had delivered the nation from tyranny and superstition, the deed went on to declare, "That the dispensing power, as lately assumed and exercised, had no legal existence; that, without grant of Parliament, no money could be exacted by the Sovereign from his subject; that, without consent of

Parliament, no standing army could be kept up in time of peace. The right of subjects to petition, the right of electors to choose representatives freely, the right of the legislature to freedom of debate, the right of the nation to a pure and merciful administration of justice according to the spirit of our mild laws, were solemnly affirmed. All these things the Convention claimed, as the undoubted inheritance of Englishmen. Having thus vindicated the principles of the constitution, the Lords and Commons, in the entire confidence that the deliverer would hold sacred the laws and liberties which he had saved, resolved that William and Mary, Prince and Princess of Orange, should be declared King and Queen of England for their joint and separate lives, and that, during their joint lives, the administration of the government should be in the Prince alone. After them the crown was settled on the posterity of Mary, then on Anne and her posterity, and then on the posterity of William" (Macaulay: *History of England*, Chap. X).

On the very next day (February 13) Garter King-at-Arms proclaimed at Whitehall William and Mary King and Queen of England, and on April 11 they were crowned in Westminster Abbey.

Declaration of Rights

On the tenth day after their accession royal assent was given to the Bill constituting the Convention a Parliament. It had rendered two incalculable services to the people. By framing the Declaration of Rights it had cleared the fundamental laws of the realm of ambiguity, and, by pronouncing the throne vacant and inviting William and Mary to occupy it, had destroyed, in Macaulay's words, "the false and pernicious notion that the royal prerogative was something more sublime and holy than those fundamental laws."

In October the Declaration, somewhat expanded, was vested with statutory force by the Bill of Rights. The Bill introduced a test to determine whether a Prince (or Princess) was a Papist or not, by enacting that the Sovereign should, at the Coronation, repeat and subscribe the declaration against Transubstantiation. Further it provided that no person who should marry a Papist should be capable of reigning in England, and that if any Sovereign should so marry, his or her subjects were absolved from allegiance.

Moreover it withdrew absolutely and for ever the dispensing power which had been supposed to reside, to some undefined extent, in the Crown.

In two particulars the Bill of Rights was discovered to be imperfect. It contained no safeguard for the independence of the judges, and no provision for the succession to the throne in the event of failure of issue to Mary, Anne, and William. An attempt to repair the latter oversight had, indeed, been made in the Bill that was first introduced, when the Lords designated as heir-at-law the Protestant Princess Sophia of Brunswick-Lüneburg, daughter of Queen Elizabeth of Bohemia, and also granddaughter of James I.

Possibly piqued by the detection of the omission, or because Anne gave birth to a son—the Duke of Gloucester—while the controversy between the Houses was in progress and the contingency of failure seemed too remote, the Commons rejected the suggested amendment and the measure dropped.

Act of Settlement

Reintroduced in October without this proposal the Bill, as we have seen, was agreed to. But the young Duke died in 1700 and it was impossible to leave the question of succession unsettled, with the likelihood of throwing the kingdom once more into turmoil.

Therefore in 1701 both matters were dealt with in a Bill which duly became law as the Act of Settlement. It provided that the judges should receive fixed salaries and hold office *aut vitam aut culpam* and be removable only by an address carried in both Houses.

Henceforward the Bench was free from improper pressure from the sovereign. The Bill next provided that on the death of Anne without heirs the Crown should pass to the Electress Sophia and her Protestant descendants.

With the Bill of Rights, securing the liberties of the people, and the Act of Settlement, securing their religion and the throne, the "glorious Revolution" was consummated.

This Bill ranks with Magna Carta and the Habeas Corpus Act as one of the main bulwarks of British liberties.

Together they form, perhaps, the distinctive feature of the British constitution. These rights, so dearly won, are assuredly among the most treasured possessions of Englishmen, and they have not failed to arouse admiration and envy in foreign lands. J. A. M.

Continued from page 148.

SCIENCES:

Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc., D.I.C., F.G.S.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc.[Lond.], A.R.C.S., D.I.C., F.G.S.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc.[Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

BOTANY.—XVI

46. Examination of a Flower. — We now turn to the process of reproduction, which is the especial work of the flower. The flower is really an aggregation of structures, all of which are in their ultimate origin modified leaves. The leaf-like nature is not obvious in most of the parts of the flower, but the steps of the evolution can be traced through the kindred structures of lower plants. Of the parts of the flower, some are essential to the work of reproduction, so that without them this function of the flower would fail; others are merely accessory organs, useful but not indispensable.

We will examine first the flower of a *tulip*. Our description will also apply, with slight changes only, to the bluebell, lily or hyacinth. The conspicuous part of the flower is a whorl of six petals, forming the *perianth*. In most flowers, as we shall see, we find the perianth to consist of two whorls—the *calyx* (composed of *sepals*) and the *corolla* (composed of *petals*). Here the sepals are indistinguishable from the petals in appearance; nevertheless, it will be observed that three members of the perianth are outside the other three and are inserted below them. We may therefore speak of the perianth as composed of two whorls, though at first sight there seems to be but one.

Inside the perianth we notice two types of structure. First, there are six *stamens*, forming the *androecium*. Each of these stamens consists of an *anther*, mounted on a rather short stalk, or *filament*. Like the perianth, the androecium really consists of two whorls of three each; one stamen corresponds in its insertion to one member of the perianth.

Secondly, when the petals and stamens are withdrawn, there remains the central part of the flower, known as the *gynæcium* or *pistil*. This consists of a rather elongated green structure, called the *ovary*, which is prolonged into a short thick *style*, which in its turn expands into a three-rayed expansion, the *stigma*. If the ovary is cut across transversely, it is seen to be divided into three chambers, which are filled with tiny white bodies called *ovules*. These ovules arise on the inner corner of each compartment where a definite ridge (the *placenta*) is easily recognisable. The petals and stamens take their origin beneath the ovary, and this is therefore described as *superior*.

Demonstration XXXII

The student should learn to make these observations and to recognise each of the organs here indicated before proceeding further. Suitable flowers for his purpose at this stage are: Lily, Bluebell, Harebell, Pansy, Fuchsia, Willowherb, Wallflower, Geranium, Garden Nasturtium. Several of these should be examined, and their points of difference noted.

The results of these observations may be summarised in a *floral formula*, *e.g.* Tulip: P3 + 3, A3+3, G[3]; Wallflower, K4, C4, A6, G[2]. In the letters P, K, C, A, G stand for perianth, calyx, corolla, androecium, and gynœcium respectively. When the individual parts of any of these organs are united into one, the number is enclosed in square brackets; e.g. C[5] would mean that there are five petals united to form one corolla. If the stamens are attached to the corolla, the fact is indicated as in the formula applying to the foxglove given on page 196.

The petals of the tulip are arranged evenly round the circumference of a circle; the symmetry

of the flower is therefore radial, or *actinomorphic;* this may be represented in the floral formula by ⊕. The sweet pea is clearly not symmetrical in this way, but one plane only will divide the flower into two corresponding halves. Such a flower is *zygomorphic*, and can be represented in a floral formula by the symbol †.

Two examples of complete floral formulæ are :—

Crocus : ⊕, P3+3, A3+0, G[3].
Foxglove : †, K[5], C[5], A4, G[2].

In order to be able to picture the floral arrangements still more clearly, two kinds of flower-diagrams should be drawn.

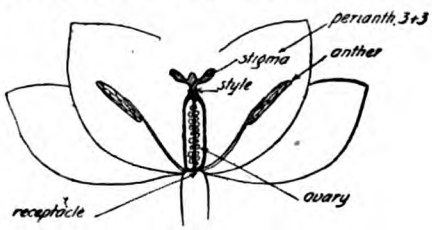


Fig. 104.—Tulip : a median longitudinal section.

(1) The *median longitudinal section* (Fig. 104) should represent diagrammatically what is seen when the flower is cut through lengthwise along the median plane. The section should pass down the centre of the ovary so as to show the position of the placenta, and should show clearly the position of insertion of each part. In the case of zygomorphic flowers the section should be taken through the plane of symmetry.

(2) The *floral plan* (Fig. 105) represents the arrangement of the parts on a horizontal plan. The floral structures are pulled off, and set out in their proper relative positions on five concentric circles. To draw the plan, first put in lightly the five circles to represent the five whorls which a complete flower has ; then draw the line PA through the centre to represent the antero-posterior plane. This is a plane which bisects the flower, and includes the stalk. That portion of the flower which is seen to be in the front, i.e. which leans towards the stalk, when the flower is in its natural position, is described as *anterior ;* the hinder or upper part as *posterior*. It is important, before starting to draw the floral plan, to find out which organ—whether a sepal or a petal—occupies the anterior position in the flower. In the tulip it is one of the sepals, and we have shown this in the plan by its relation to the stalk, A. We shall show in later plans how the union of organs and other details can be represented. Meanwhile, the student should study carefully the relation between these sketches and his own observations, and should draw similar sketches for himself from any of the flowers mentioned above. It is convenient to have a set of coloured pencils, and to represent each part constantly by the same colour.

Fig. 105.—Tulip : a floral plan.

47. The Parts of the Flower.—As the student extends his observations of flowers, he will become more and more impressed with the great variety that exists amid the essential simplicity of flower-structure. In this section we lay stress on the more important points to be observed, though many books would not exhaust all that might be said.

The flower is generally supported on a stalk, though some are sessile ; and the end of the stalk is usually modified for the reception of the flower into a *receptacle* or *torus*. This receptacle may be a flattened expansion, or a conical prolongation of the stalk, or even be hollowed out ; or again, it may be indistinguishable from the rest of the stalk. Only occasionally is it really conspicuous ; but sometimes, as in strawberry, it plays an important part in the formation of the fruit.

Examine the receptacle of the following :—Wild Rose, Bramble, Hawthorn (May), Blackthorn, Wallflower, Foxglove, Daffodil, Iris, Fuchsia. Make clear sketches.

The calyx (*k*) consists most commonly of a whorl of small green sepals. But frequently the sepals, while remaining green, are large and strong, acting then as a protection of some kind. Thus the petals of a wallflower would collapse if the strong calyx did not uphold them. Sometimes the calyx is the conspicuous part of the flower ; in these cases the corolla is either absent, as in wood-anemone, or greatly reduced, as in monkshood. In larkspur both calyx and corolla contribute to the showy part of the flower.

After the flower is fertilised. the calyx usually falls off, i.e. is deciduous ; but sometimes it is persistent, as in apple, strawberry, etc. In the poppy there are two sepals, large and green, which act as protectors to the rest of the flower before the bud opens, and then fall off.

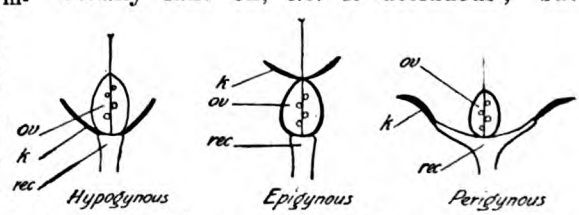


Fig. 106.—Showing how the calyx (*k*) may arise under the ovary (*ov*) when it is hypogynous ; on the ovary when it is epigynous ; or on the edge of the receptacle (*rec*) when it is perigynous.

When the sepals forming the calyx are free they are known as *polysepalous ;* when united, wholly or partially, they are called *gamosepalous.*

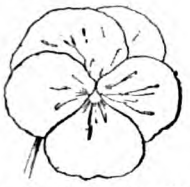


Fig. 107.—Corolla of Viola.

Fig. 108.—Corolla of Orchis pyramidalis.

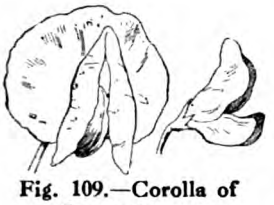


Fig. 109.—Corolla of Sweet Pea.

Fig. 110.—Corolla of Snapdragon.

The calyx may arise under the ovary, when it is *hypogynous ;* or on the ovary, when it is *epigynous ;* or it may arise from the edge of a receptacle which has partly enclosed the ovary, when it is called *perigynous* (Fig. 106). These terms apply also to the corolla and to the andrœcium. In describing the calyx, attention must be paid first to these points ; then to the size, shape, colour, nature of surface, etc., of the individual sepals.

The corolla consists of a whorl of petals, usually equal in number to the sepals, though sometimes less, by suppression or modification of some of them. Generally the corolla is large, brightly coloured and conspicuous. It is much reduced or absent in some cases, where the calyx takes the prominent part ; and a large number of flowers, which have no need to advertise themselves to insects, have neither corolla nor calyx, or only some tiny scales which are of no service to the flower. The corolla takes many shapes, being either actinomorphic or zygomorphic. But the variety is greater than is indicated by these two words ; indeed, we should require dozens of terms if we set out to describe them all.

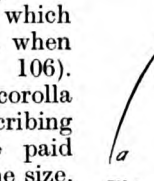


Fig. 111.—Single petal of Wallflower.

Zygomorphic corollas result from the modification of one or more petals, either in size or shape. A common modification is that seen in pansy, larkspur, etc., in which one of the petals (or sepals) is prolonged into a long tapering tube, called a *spur.*

In the orchids, moreover, one petal becomes so different from the rest as to give most extraordinary shapes to the flower. The sweet pea has one very large petal in the posterior position ; the snapdragon has its five petals united so as to form two firmly-closed lips ; and so on, in the greatest variety (Figs. 107–110).

The corolla may be *polypetalous* or *gamopetalous ; hypogynous, epigynous,* or *perigynous ;* deciduous, or persistent. Generally petals, like sepals, are sessile or have very short stalks ; occasionally they are *clawed,* i.e. have a kind of stalk at right angles to the expanded portion, as in wallflower and pink (Fig. 111). In describing a corolla, attention must be directed to its arrangement, insertion and shape ; to the shape of the individual petals ; to their colour, and to any markings or hairs that may be on them.

Fig. 113.—Anthers ; (*a*) versatile, (*b*) basifixed, (*c*) adnate, (*d*) of Grass, (*e*) of Rhododendron, (*f*) of Tulip.

The andrœcium constitutes, along with the gynæcium, the essential organs of the flower. It consists of *stamens,* which in number usually exceed the petals or sepals. In a perfect flower there would be, as in tulip, twice as many stamens as petals ; but often the number is much greater, or *indefinite* (∞) ; and sometimes it is reduced to the same as the petals, or even less, as in speedwell, lilac, etc. The stamens are usually free ; but we find them also united by the filaments so as to form a tube, and in the pea family we find nine of them thus

Fig. 114.—Primrose cut open so as to show adhesion of stamens to corolla.

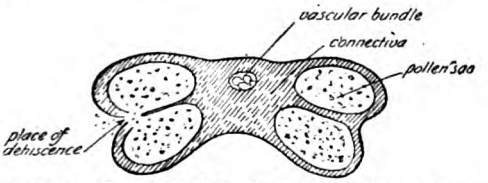


Fig. 112.—One half of Anther, showing commonest method of dehiscence, i.e. a slit along each lobe lengthwise between the two pollen sacs.

united, leaving an odd one free (*diadelphous*). In the orchids the filaments are fused with the style (*gynandrous*); and in members of the daisy family the anthers are pressed close to the style so as to lean upon it (*syngenesious*).

The important part of each stamen is the *anther*. This is easily seen to be composed of two lobes connected together by a continuation of the filament called the *connective*. A transverse section of the anther shows each of its lobes to contain two cavities, the *pollen-sacs*, which, when the anther is ripe are filled with *pollen grains*. These pollen grains are exceedingly small and numerous, and they form a very fine dust which is easily carried about by the wind.

At the proper time the anther opens, or *dehisces*, as the scientific word is, and exposes the pollen so that it may easily be seen. The method of dehiscence varies. The commonest way is by a slit along each lobe lengthwise between the two pollen-sacs, as shown in one half of the anther of Fig. 112. But sometimes the slit is only a short one, and in a few cases a small hole or pore forms at the top of each lobe.

When the anther dehisces inwards it is described as *introrse*; when outwards, as *extrorse*. If the filament joins the anther at the middle, so that the anther can swing into either position, the latter is described as *versatile*; if the anther is fixed by one end, it is called *basifixed*; if the filament runs up the back of the anther, it is *adnate* (Fig. 113).

The stamens may be hypogynous, etc., like the petals and sepals; they may also be *epipetalous*, inserted on the corolla; and this is a very frequent arrangement.

E. W. E.

GEOLOGY.—II

Different Classes of Rocks.—A rock may be defined for geological purposes as an aggregate of mineral particles. Loose sand and soft clay are rocks as well as their consolidated equivalents, hard sandstone and fissile slate. In the Mineralogy Course, Vol. IV., p. 207, a piece of granite was described with its three mineral constituents—felspar, quartz, and mica.

Some of the felspar and mica crystals, it was noted, had developed their own characteristic external form. This points to growth by crystallisation from a molten rock-solution or *magma*.

The quartz crystals were not characterised by any special shape; they evidently formed where they could, filling up the spaces between the crystals of an earlier growth, and so completing the solidification of the rock. Granite is, in fact, one of the most familiar examples of rocks which have formed by direct crystallisation from a molten condition.

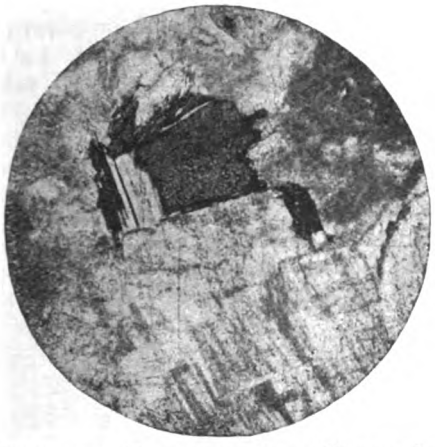
Granite is an example of a rock which has solidified from a fused condition far below the earth's surface, where cooling took place so slowly that the whole rock was built up of comparatively large crystals. Rocks of this kind, which owe their origin to the solidification of fused magmas, are called *Igneous Rocks*. The magmas themselves have their origin within the earth's crust, and they tend to move while in the fused state from within outwards, reaching the surface in the case of active volcanoes.

The magmas may therefore be correlated with geological processes of internal origin, which may be conveniently referred to as *Endogenetic* processes. They also give off gases and vapours and hydrous solutions, and these not only affect and alter the neighbouring rocks, but are, besides this, responsible for vein-rocks and ore-deposits and deposits around volcanoes, all of which have this in common, that they are essentially due to endogenetic processes.

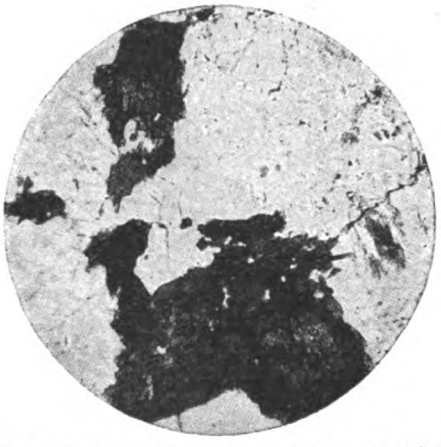
All rocks, igneous or otherwise, which are shown to be due to endogenetic processes are grouped together as *Endogenetic Rocks*, and all ore-deposits which are due to similar processes are called *Endogenetic Ore-Deposits*.

If a piece of *sandstone* be now examined, it will be found that it consists of broken and rounded grains of quartz, with perhaps a few shining plates of mica lying in parallel layers, the whole made strong and compact by some cementing material. A *conglomerate* consists of rounded pebbles which are embedded in cementing material. It is like concrete, and may be regarded as a natural concrete.

It is clear from their structure that such rocks are made from fragments of pre-existing rocks, the sandstone corresponding with loose sands like those of the seashore, and the conglomerate with loose pebbles like those which accumulate in the upper parts of the beach. Such rocks, whether they are loose or cemented, whether they are deposited on the seashore or under the sea, in lakes or rivers or on the land, are all grouped together as *clastic* or *detrital* rocks, being formed from the broken-up debris or *detritus* of pre-existing rocks. They owe their origin to the mechanical processes



MUSCOVITE GRANITE : from Cheesewring, Cornwall.

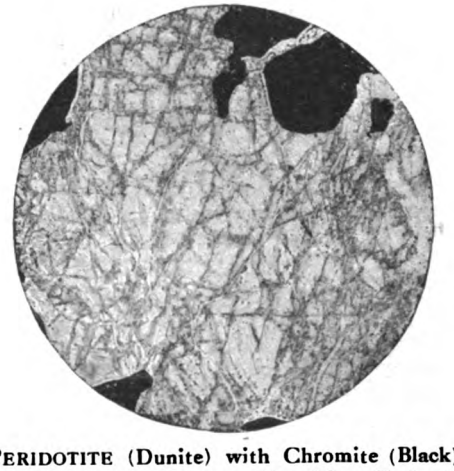


HORNBLENDE GRANITE : from Rubislaw, Aberdeen.

HORNBLENDE SYENITE : from Dresden.

DIORITE : from Glen Tilt, Perthshire.

GABBRO : from Ilchester, Maryland.



PERIDOTITE (Dunite) with Chromite (Black) and Olivine : from Dun Mt., New Zealand.

PHOTOMICROGRAPHS OF IGNEOUS ROCKS

as viewed in thin sections under a microscope (*cf.* p. 143).

which operate at the surface of the earth and by which rocks are broken up into fragments, carried away and sorted out, and deposited as a new rock-formation.

Note again that rocks are broken up, however, not only by mechanical means, but also by the chemical action of the atmosphere and rain. Solutions are formed and from them fresh deposits may be precipitated either directly by chemical action, or indirectly through the agency of living organisms. Rock-salt is an example of the first type, and limestones made of shells are characteristic deposits of the second type.

All of these rocks, generally called *sedimentary* rocks, whether they are formed by mechanical, chemical, or organic agencies, owe their origin to geological processes of external origin, which may be conveniently referred to as *Exogenetic* processes. Correlating the rocks with the processes whereby they are formed, all rocks, sedimentary or otherwise, which can be shown to be due to exogenetic processes may be grouped together as *Exogenetic Rocks*, and all ore-deposits which are due to similar processes are called *Exogenetic Ore-Deposits*.

Mode of Occurrence of Sedimentary Rocks.—Sedimentary rocks are rocks which

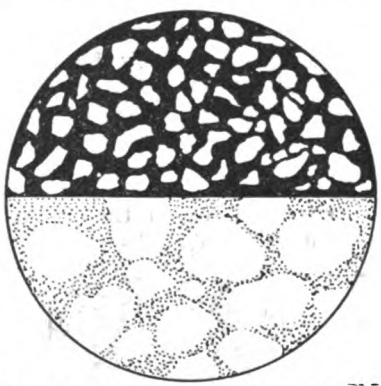


Fig. 4. — Micrograph of sandstones showing (*top*) ferruginous cement, and (*bottom*) clayey cement.

are made up of detrital sediment, and deposits formed by precipitation from surface solutions are also included as sedimentary. They constitute by far the greater proportion of the exogenetic rocks. Sediments are laid down on the land or in water in layers which are horizontal. On the sea floor they may be of very wide extent.

Individual layers having a fairly uniform composition are called *beds* or *strata*, and the rocks which exhibit this structure are said to be *stratified*. A section of sedimentary rocks seen in a cliff, or quarry, or railway cutting will often illustrate a succession of beds, each one differing from its neighbours in colour, coarseness of grain, or composition, and separated from them by planes of division. The occurrence of sedimentary rocks in strata of varying character is referred to as *stratification*.

A smaller structure, which gives certain stratified rocks the appearance of being divided up into very thin layers parallel to

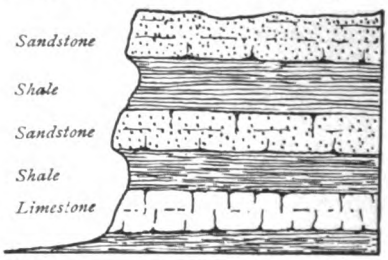


Fig. 5.—Stratification of sandstone, shale, and limestone in a cliff section.

the strata, is described as *lamination*. It is found only in rocks which have been buried beneath a considerable thickness of sediment, and is due not to varying composition in successive laminæ, but to the pressure produced by the piled-up rocks above. The effect of this pressure is to make the rock particles rearrange themselves so that their longest axes are perpendicular to the direction of the pressure.

Bands are thus produced in which the flatter rock particles are all arranged in one way, so that the rock easily splits along them. A soft mud may show no trace of lamination, but after it has been subject to pressure it becomes fissile, is easily split into thin flakes, and is known as a *shale*.

Mode of Occurrence of Igneous Rocks.—Igneous rocks are those which have formed from the solidification of fused rock material. They constitute the most important class of endogenetic rocks. Fused rock material is known as *magma* while it remains within the earth, and as *lava* when it rises upwards and pours itself out.

Owing to the tendency of rock-magmas to move upwards towards the earth's surface, igneous rocks may be divided into two main types according to their mode of occurrence. Those which have been injected into the crust without reaching the surface are called *intrusive* igneous rocks. Those which have succeeded in breaking right through and flowing from craters or fissures as lava-flows are called *extrusive* igneous rocks.

Lava-flows spread themselves out in sheets parallel to the ground over which they flow before coming to rest. The intrusive rocks occupy spaces which were previously filled by other rocks. Sometimes the pre-existing rocks are thrust aside or arched upwards;

Fig. 6.—Intrusive igneous rocks, i.e. those which have not broken through and flowed from volcanoes as lava flows (e.g. the granite masses of the British Isles) may take the form of *domes* (circular or oval in outline) or bosses (irregular in outline).

sometimes no trace of them can be found, and the mechanism of the intrusion is very difficult to understand. The greater granite masses of the British Isles afford good examples of the latter case. Immense domes of granite have intruded into the surrounding sediments, cutting through them regardless of their structure. Such an intrusion

Fig. 7.—Showing a sill, i.e. an intrusion which has forced its way along the stratification planes of bedded rocks.

is called a *dome* if circular or oval in outline, or a *boss* if irregular. *Sills* are intrusions which have forced their way along the stratification planes of bedded rocks. They thus lie parallel to the strata. The Great Whin Sill of the north of England is a famous example which covers an area of thousands of square miles and yet retains a fairly uniform thickness. It lies in the Carboniferous rocks and sometimes breaks across the strata from one set of beds to another.

A *laccolite* may be regarded as a special form of sill in which the overlying beds have been arched up, while the base remains more or less flat.

When the intrusion is roughly at right angles to the stratification instead of being parallel to it, it is called a *dyke*. A dyke is thus a wall-like mass of igneous rock intruded into a fissure with nearly parallel sides cutting across the bedding planes.

Small irregular intrusions into cracks and fissures are termed veins, and if either dykes or veins can be seen to be in visible connection with a larger body of igneous rock they are said to be *apophyses* of the latter.

The material of a lava-flow has necessarily been drawn from a deep-seated supply of magma, and it rises to the surface through the pipe of the volcano from which it flows. The pipe itself, therefore, constitutes a special form of igneous intrusion which is sometimes found in ancient volcanic regions as a hard, outstanding cylindrical mass of

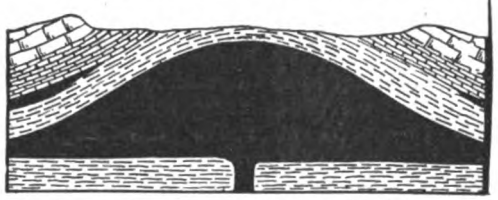


Fig. 8.—A laccolite is a form of sill in which the overlying beds have been arched up while the base remains flat.

igneous rock, and is generally described as a volcanic *neck*.

Distinguishing Characters of Igneous and Sedimentary Rocks.—I. (*a*) Igneous rocks are made up of crystals or natural glass, and the minerals which enter into their composition have developed as original or primary constituents during the crystallisation of the rocks from a molten condition.

(*b*) Igneous rocks have crystallised or solidified from a molten condition, the fluid magma having originated within the earth under conditions of high temperature. For this reason they belong to the class of endogenetic rocks.

Fig. 9.—An intrusion roughly at right angles to the stratification is called a dyke.

(*c*) Igneous rocks attained their present positions while they were in a state of fusion. Their modes of occurrence show

that in forcing an upward passage towards the surface they displaced the neighbouring rocks, cutting through them and forcing them aside, or raising them up. They are therefore said to be intrusive, or extrusive when they reach the surface as lava-flows.

(*d*) Igneous rocks are formed under high temperature conditions which forbid the existence of life. They are therefore free from fossils.

II. (*a*) Sedimentary rocks are made from the broken-up debris of pre-existing rocks and minerals, or else by the precipitation of materials held in aqueous solution, dissolved during the chemical action of weathering on pre-existing minerals.

(*b*) Sedimentary rocks are generally formed through the agency of water or air, acting at ordinary temperatures at the surface of the earth, and they therefore belong to the class of exogenetic rocks. Deposits carried by and laid down in water are sometimes called aqueous rocks, and those carried by the wind and laid down on the land are called æolian sediments.

(*c*) Sedimentary rocks have been carried to their present position by the action of water, ice, or wind, and except when they have been tilted up or folded by later earth movements, they lie in widespread horizontal sheets. They are therefore said to be stratified.

(*d*) Sedimentary rocks are formed under conditions which favour the existence of living organisms, and they often contain the fossil remains of plants and animals which flourished at the time of their deposition.

A. H.

ZOOLOGY.—XXIX

THE class *Reptilia* comprises some ten different orders, seven of which, however, are now extinct. Though existing orders show a certain affinity to birds, the relationship is less marked than, in the case of the extinct orders, it once was.

Reptiles

All reptiles are cold blooded, and for some reason they produce a sensation of abhorrence. That they are cold to the touch may contribute to this effect, though it can scarcely be said fully to explain it, since the same fact is true of fish. The descent of the reptile is complicated by the fact that it cannot be traced back to a particular group, in the fashion that birds may be said to descend from reptiles. The majority of the reptiles, it is true, trace their origin to a particular group of extinct Amphibians, but there remains an extinct order that is certainly of Mammalian ancestry.

Dealing with existing orders we find them in most abundance in hot climates and in scantier numbers in more temperate regions. The majority are flesh eaters, and though most reptiles possess limbs, the majority can be said to crawl rather than to walk.

One of the most important of the existing orders of *Reptilia* is the Squamata, which includes both snakes and lizards. This order again is divided into sub-orders, the first of which, the Ophidia, includes the snakes. The most notable peculiarity of this sub-order is undoubtedly the absence of limbs, which are either entirely lacking or of which at the most only a few vestiges remain. The snake, in fact, has discarded his legs in favour of his ribs, or, to be more precise, in favour of innumerable scales which thanks to their backward "set," glide easily over the ground when pulled forward, but grip the earth when required to propel another part of the body.

Snakes

Though the limbs have disappeared, however, some snakes still retain certain vestiges of claw and bone, which indicate beyond all doubt that they once existed. In the case of the boas and pythons, a family that includes the largest of existing snakes, traces of hind limbs are found internally in the skeleton and externally in small, claw-like spurs.

The snake's tongue is long and forked, but, though alarming in appearance, is actually harmless. In the case of the non-poisonous snakes the teeth are usually fairly formidable; sloping from the gums towards the back of the mouth, they practically forbid their owner to cease his meal until the whole of it is consumed, since each bite tends to draw the mouth perceptibly further over the carcase of the victim. And this, indeed, would appear to be the principal work of these fangs, since the snake relies much more upon his truly excellent powers of digestion than upon any ability to masticate his food. His mouth, in fact, is merely concerned to place within his stomach anything that may enter his jaws.

The extent to which this is the case has been demonstrated by more than one accident to captive boas. Placed two in one cage they have been known to attack the same piece of food from opposite ends, with the

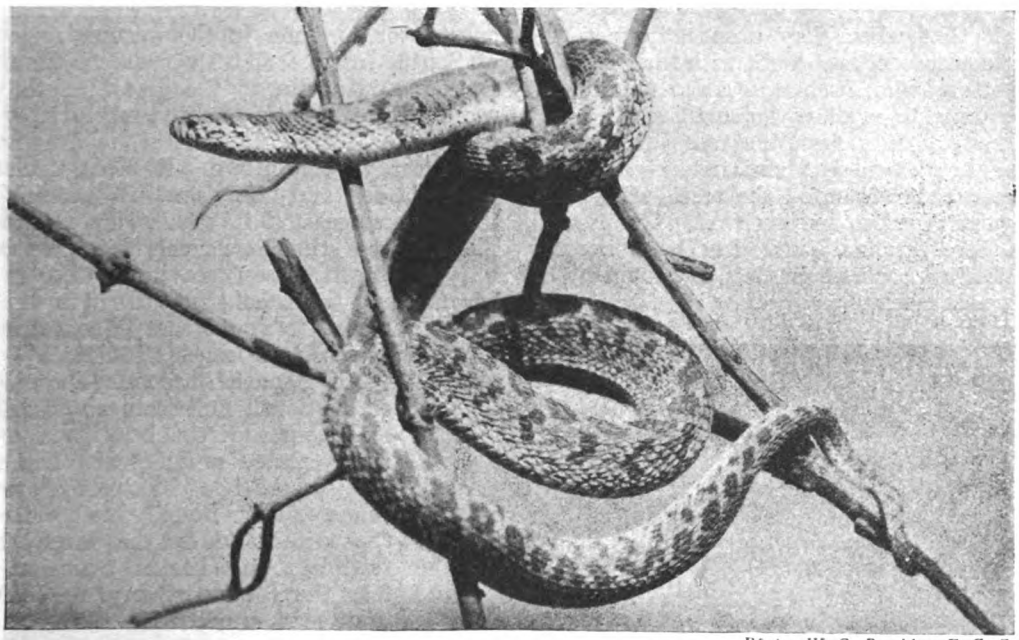
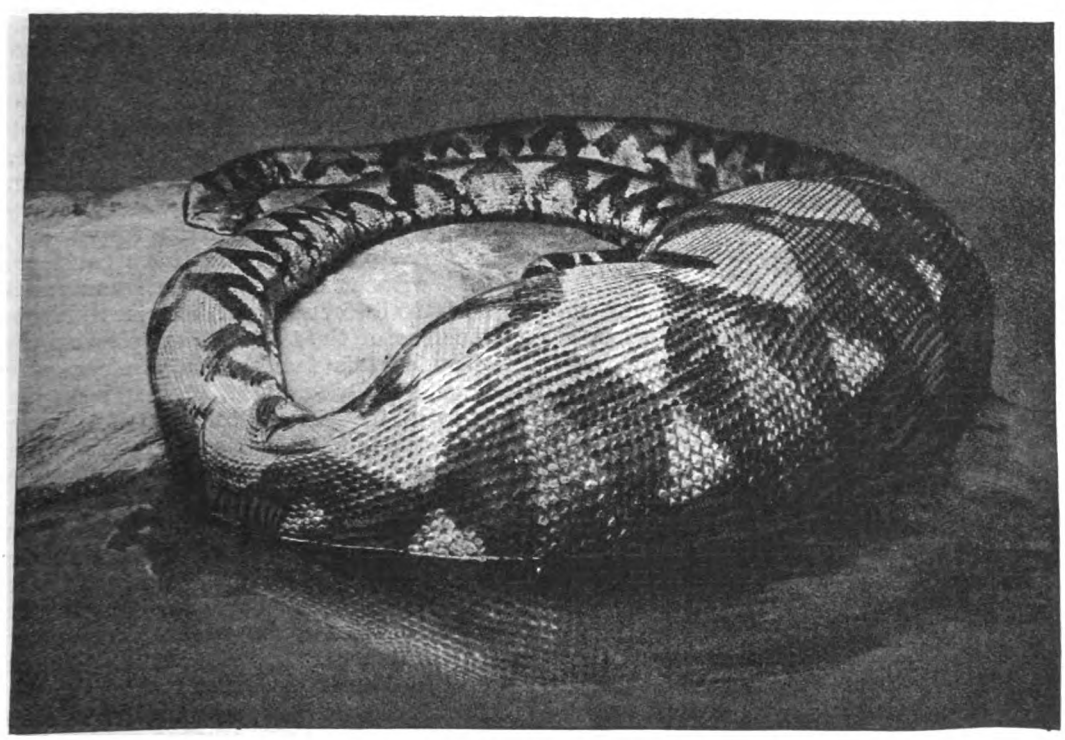


Photo: W. S. Berridge, F. Z. S.

THE EGG-EATING SNAKE

of S. Africa crushes its food by means of bony projections in the gullet, swallows the contents, and ejects the shell.



THE INDIAN PYTHON

is one of the largest of the reptiles; it sometimes attains to a length of thirty feet.

result that when they eventually met the larger proceeded, no doubt with the reluctant air of one who discharges a sad but inevitable duty, to swallow the smaller.

The poison snakes, the most dreaded of their kind by beast and man, have to a large extent discarded the teeth which distinguish the boas and pythons. The process has been gradual, and has been accompanied by a corresponding development of the poison fangs.

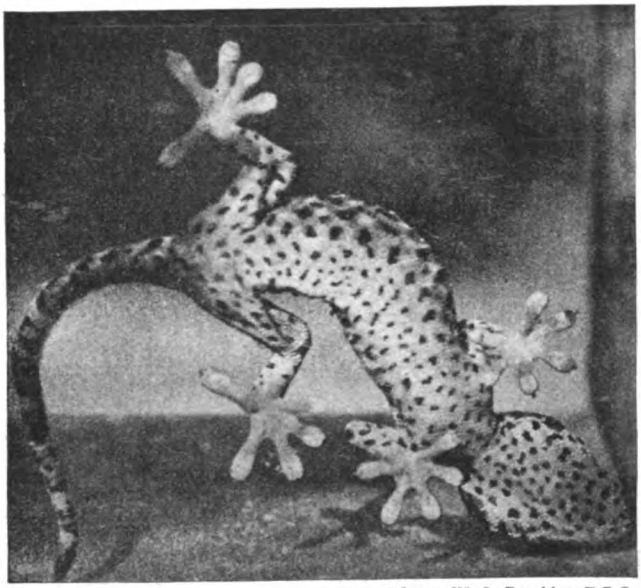


Photo: W. S. Berridge, F.Z.S.

THE GECKO,

which, in common with other of the smaller lizards, is able to run up even polished perpendicular surfaces owing to the sucker-like disks on its toes.

Snakes are usually short-sighted and, it is said, are poor judges of distance, though it is probable that the extent of the latter defect varies with the condition of the eyesight. The young of the species are born from eggs, though not always in similar fashion. In some cases the egg is hatched out by the heat of the sun; the python on the other hand incubates her own eggs by coiling herself round them; in still other species the young break from eggs still in the body of the parent.

The family *Boidæ*, which consists of the boas and pythons, includes the largest of living snakes. The boa and the python find compensation for their lack of poison fangs in their great muscular strength. They can crush the largest mammals and can make a meal off a young deer by first crushing it to suitable dimensions. The Boa-constrictor common to the warmer regions of South America and Madagascar, though it does not attain to the great length of some members of this family, rarely if ever perhaps exceeding fifteen feet, is amongst the most widely known. It feeds usually upon birds and the smaller mammals, though on occasion it tackles larger prey. The Indian Python is a much larger reptile. Varying lengths have been attributed to it by different travellers, but there is small reason to doubt that it sometimes attains to a length of 30 feet.

The gigantic Anaconda, a denizen of the South American tropics, differs from the true boa in that it has a plated muzzle, whereas the head of the boa is covered with small scales. Equally at home in the water and on the land, this terrible reptile has no occasion to fear the attack of any foe other than man armed with a rifle. In length it frequently exceeds thirty feet, though it is probably necessary to accept with caution some of the extraordinary estimates vouched for by explorers. The food of the Anaconda consists both of mammals and birds, which are captured mainly at night both on land and in the water. The young are produced alive.

The family *Columbridæ* includes all the snakes of the *Ophidia* other than vipers, pythons and boas. The members of this family carry numerous teeth in the upper jaw, have well-developed eyes, and are without those traces of once existing limbs to be found upon the boas. Three subdivisions of the *Columbridæ* split up the members of this family into snakes with teeth solid and ungrooved, snakes with one or more of the hinder teeth in the upper jaw grooved, and snakes with front upper teeth grooved or perforated.

To the first division belong the two harmless snakes to be found in Britain, the Common Snake and the Smooth Snake. The first-named species is more common than the second, and both are found, but rarely in Scotland. No snakes at all are found in Ireland. To the same division belongs the African Egg-Eater, which crushes its food by means of bony projections in the gullet, swallows the contents and ejects the shell.

In the second of the divisions given above come the Indian Tree Snakes, the Indian

Egg-Eating Snakes and the Oriental Water Snakes, most of whom are venomous, but not dangerously so.

The third division, however, greatly exceeds the first and second in interest since it contains the dreaded cobra group. The various species of cobras, of which there are some half a dozen, are characterised by the power of inflating the neck or hood, as it is termed, and are readily distinguishable by the spectacle-like markings which ornament it. These snakes are exceedingly deadly, though a curious affection for music will frequently cause them to forget their hostile intentions, at any rate for a time.

The Indian Cobra attains a length of from five to six feet. Other well-known species are the African Cobra or "Asp" and the Giant or King Cobra. The venom of the cobras retains its poisonous properties for a considerable period, even in a dried condition. It is said to have proved effective after being preserved for so long a time as twenty-two years. The method of the cobra when attacking is to raise his head and to strike forward and downward, in this respect he differs from the viper who thrusts from ground level.

The true Krait is said to cause more deaths in India than any other snake. The Death's Adder, the most dangerous of Australian snakes, attains a length of between six and seven feet.

The Sea Snakes, which belong to the same sub-family as the cobras, are the innocent heroes of many amazing yarns, not to use any stronger term. If we could investigate every sea serpent story that has ever sent a thrill through an astonished reader, we should probably find that where their origin lay neither in imagination nor seaweed, it could safely be attributed to the sea snake. But though the small sea snake of to-day may appear a simple antagonist when compared with the prodigious monster of prehistoric times, he is, as a matter of fact, quite as dangerous, indeed more dangerous.

He fights in the truly modern fashion. Nature has discarded the "three decker," and given us the submarine. His colouring is protective—it resembles very frequently that of the mackerel—his body is adapted to movement through the water, he is swift, silent, deadly. From the Persian Gulf to Central America the sea snake haunts the tropical seas, living principally upon fish, but killing with swift and sudden poison anything that threatens it, even man.

The family *Viperidæ*, comprising the Vipers, bears an unenviable reputation, for all its members are poison bearers. The poison

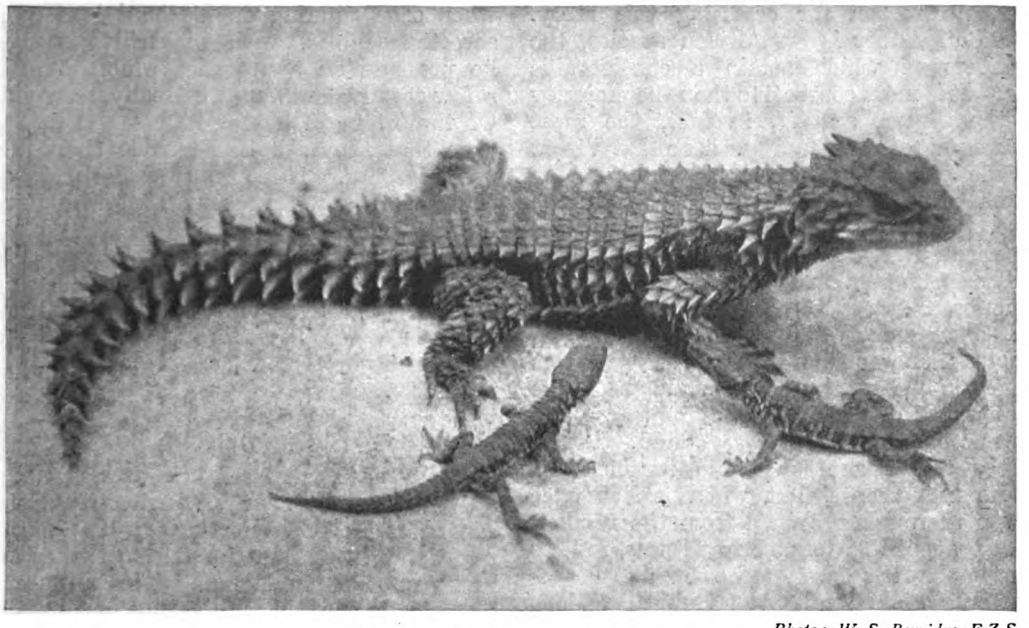


Photo: W. S. Berridge, F.Z.S.

GIANT ZONURE AND YOUNG.

The Zonure is a S. African lizard, covered with strong bony scales, which form sharp spikes on the tail.

fangs are situated at the front of the mouth, and are supported by short and otherwise toothless maxillary bones. Should the poison fangs be broken off, as happens not infrequently, their place is taken by other teeth developed behind them. All the species are viviparous.

The Common Viper or Adder attains a length of two feet or so in this country, and an even greater length elsewhere in Europe. It is said of the young of this species that in time of danger they take refuge within the body of the parent. There exists, however, no reason for crediting this story. The Puff Adder is an African species, the members of which attain a considerable size. It is more combative than the majority of the vipers, and is, in fact, the most dangerous of the family. The Pit-Vipers are so called from the pit or depression which they carry between the eye and the nose. Of these the best known are the American Rattlesnakes.

The Common Rattlesnake of North America attains to a length of between four and six feet, and as everybody knows, derives its name from the horny rings which form the end of the tail. When the snake is angry or fearful, the tail is agitated, and thus occasions a rattling sound. Fortunately this snake is by no means swift in its movements, but when it has once bitten there is no appeal from the verdict. Death, agonising, terrible to witness, follows hard upon the blow. The terrible Bushmaster, which haunts the tropical regions of South America, is another member of this ill-omened family. Twelve feet or more in length, it lurks in the dark forests, the terror alike of man and beast.

Lizards

The second sub-order into which the Squamata has been divided is known as the *Lacertilia* or lizard group, a wonderful family containing over 1,750 different species.

In most cases the lizards possess limbs, and resemble to some extent diminutive crocodiles, but in certain instances the form is snake-like, the limbs being reduced or even lost altogether. Again, though the majority of the lizards are to be found on shore, there are a few species whose home is in the water. Some frequent the branches of trees, others hide beneath rocks, some crawl upon their bellies, others skim through the air like an aviator indulging in a "volplane." The lizards, in short, are of infinite variety in appearance and habits.

With one exception, however, the various species are uniformly respectable in their methods of attack and defence, only the Gila Monster of Mexico and Arizona condescends to use poison. Small birds and mammals quickly fall victims to this reptile, but the venom is not fatal to human beings. The Gila Monster is a little over a foot in length.

A lizard of most unusual appearance is the Frilled Lizard of Australia. This lizard carries round his neck a very large skin "frill" which he can expand at will. He is between two and three feet in length, and when seen running on his hind legs as he sometimes does, with his frill extended, he presents an appearance which were he a few feet higher would be really terrifying. Of the Flying Dragons it may be said at once that they are less terrible than their name implies. There are several species so-called, all of which carry wing-like membranes which are attached to extensions of the ribs. By this means these reptiles pass from branch to branch, or from one tree to another close at hand. True flights, however, is quite beyond their powers. All these "dragons" may be handled with impunity.

Chameleons

Easily the most terrible in appearance of all the lizards is the Australian Spiny Lizard or Moloch. Fortunately he is comparatively small, and for all his spikes and horns nobody minds him. The Zonure of S. Africa is covered with strong bony scales, which form sharp spikes on the tail.

The ability to run up perpendicular surfaces, even when as smooth as glass, possessed by many of the smaller lizards termed *Geckos*, is due to sucker-like disks to be found on the toes. The Gecko in question is thus able to walk, if necessary, with body downwards, since at each step he literally adheres to whatever he may be walking upon.

The Chameleons constitute of themselves the fourth of the five sub-orders included in the *Squamata*. This sub-order is known as the *Rhiptoglossa*, the family being termed the *Chamæleontidæ*.

Chameleons differ from lizards both in the structure of the tongue and in the form of the head. The wonderful fashion in which the chameleon assumes the colour of his background is, of course, popularly his best-known characteristic. But it is not so absolutely distinctive as some people imagine, being displayed to some extent by many of the Geckos. A. B.

ANATOMY AND PHYSIOLOGY. X

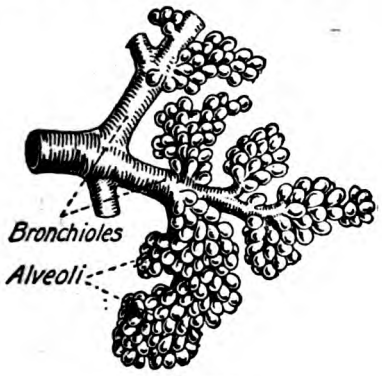
We have seen that the blood is the fluid from which the tissues take food and oxygen, and into which they discharge carbon dioxide and nitrogenous waste. We have seen, further, that the blood is passed through a circuit of tubes, and that at various points on this circuit renewal of loss and rejection of waste take place.

We have now to consider how the blood gets its supply of oxygen and rids itself of carbon dioxide, and also how the reverse of this is done in the tissues, how the blood there loses oxygen and takes up carbon dioxide.

Action of the Lungs

The whole of the pulmonary circulation is given up to this. Blood enters the right auricle by the systemic veins after it has been all round the body, and consequently is poor in oxygen, and therefore dark in colour, and rich in carbon dioxide.

It enters the right ventricle and the pulmonary artery, and by the latter it is distributed to the lungs. It passes through the capillaries of the lungs, where it takes up oxygen and loses carbon dioxide. It



A Lung

consists of a series of air balloons. The arrangement by which the air is changed is similar to that by which a bellows is emptied and filled.

becomes bright red from the presence of oxygen, and thus enters the pulmonary veins and is discharged into the left auricle.

The lungs, which are filled through the Bronchioles, consist of a series of air balloons (Alveoli), and in the capillaries of the lungs the blood is exposed to the air. If the blood is continually taking oxygen out of the air of the lungs and adding carbon dioxide to this air, the air will soon get stale and cease to serve its function. Therefore it is necessary for the air in the lungs to be changed.

The arrangement by which the air in the lungs is changed is much the same as the filling and emptying of a bellows, with one difference. In a bellows there is a valve at the side through which the instrument is filled, but it is emptied through the nozzle.

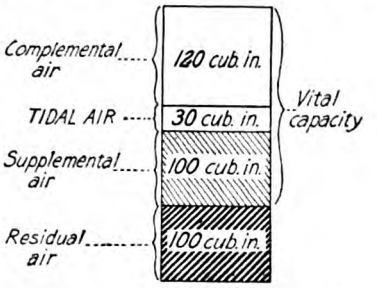


Diagram showing proportions of complemental, tidal, supplemental, and residual air in the human lungs.

In the lungs there is no valve; they are filled and emptied through the same hole. When you wish to fill your bellows, you draw the two handles apart, and so increase the space inside. Air enters through the valve or the nozzle to fill this space, otherwise there would be a "vacuum," a space with nothing in it, not even air, and there is a saying that "Nature abhors a vacuum."

In exactly the same way the space inside the chest is enlarged when you breathe "in," and air rushes down the windpipe to fill the fresh space. When you take a sudden deep breath, it is easy to think that you are sucking in with your mouth and throat. This is a mistake, the movement which draws the breath in is made with your diaphragm, and the air is only drawn through your mouth and throat.

Respiration

Respiration or breathing, then, is a method of changing the air to which the blood in the lungs is exposed in order that there may always be enough oxygen present, and that the carbon dioxide shall not be in excess.

In ordinary quiet breathing the movement of the chest is not very great, and the quantity of air which is drawn in and expelled again at each breath, called the tidal air, is about 30 cubic inches, or rather more than the contents of a cubical box each side of which is 3 inches. By vigorous inspiratory efforts it is possible to draw into the thorax about four times as much as this in addition (complemental air), or a total

of 150 cubic inches more than is present in the lungs at the end of a quiet expiration.

On the other hand, by strong expiration it is possible to expel from the chest about 100 cubic inches of air which are normally left in the chest at the end of a quiet expiration (supplemental air). Even this does not entirely empty the lungs of air, for after the most violent possible effort of expiration there will remain in the lungs about 100 cubic inches of air which is impossible to get rid of by any voluntary effort.

If we add these quantities together, it appears that the total amount of air which the lungs are capable of containing at any one time is about 350 cubic inches.

The Air We Breathe

The amount of air which can be drawn into the chest by the most vigorous possible inspiration following the most forcible expiration, or which, conversely, can be expelled from the chest by the most forcible possible expiration, is sometimes called the "vital capacity." It differs, of course, in different individuals, according to the size of the chest and the vigour of expansion; but on an average it may be taken as 250 cubic inches.

The air one breathes is a mixture of gases, not a combination. In 100 parts of air there are about 20 parts of oxygen, which is the important gas for breathing, and about 80 parts of nitrogen, which only dilutes the oxygen, just as you dilute spirits with water. The air you breathe out is different in character from the air you breathe in; it contains only 16 parts per cent. of oxygen, and it contains 4 parts per cent. of carbon dioxide. There are only traces of carbon dioxide in fresh air.

Breath also contains a great deal of water—it is said to be "saturated with watery vapour"—and if you breathe on to a smooth cold surface like a looking-glass, the water condenses on the glass, and if you go on long enough it will roll down in drops. The lungs are one of the chief places where water is got rid of.

If, therefore, you compare the fresh air you breathe in with the foul air you breathe out, you find that the fresh air has lost oxygen and has gained the same amount of carbon dioxide, and also has become full of water.

What is the bellows arrangement of the chest by which the fresh air is taken in and the foul expelled? The chest or thorax has been seen to be a bony basket, conical in shape, made up of the spine and twelve ribs. During rest the ribs slope downwards, and the chest is closed below by the dome of the diaphragm. The spaces between the ribs are filled by the *intercostal* muscles, outer and inner. The fibres of the external intercostals slope forwards from above, that is they join each rib to the one next it, and the fibres are attached to the upper rib at a point nearer to the spine than they are to the lower rib; the fibres slope forwards. The internal intercostals are attached in the opposite way; their fibres run down and back, and are attached to their upper rib farther away from the spine than they are to their lower rib.

Ordinary breathing is carried out by the diaphragm and the intercostal muscles. The diaphragm is attached round the inside of the lower edge of the chest, and its dome rises up into the chest.

Inspiration and Expiration

Breathing "in," or "inspiration," is done chiefly by the diaphragm, its fibres contract, and so flatten the dome and increase the space in the chest, and air enters through the throat. The size of the chest is further increased by the external intercostal muscles, assisted by some small muscles called the *levatores costarum*, the "raisers of the ribs"; they run from each vertebra to the rib below it, and their fibres lie in the same direction as those of the external intercostals. The levatores costarum and the external intercostals contract at the same time as the diaphragm, and lift up the ribs from a sloping to a more horizontal position. This has the same effect as if you stood your bellows upside down, let one handle rest on the floor and pulled the other one out; the chest is filled just as the bellows would be. When you breathe in and the diaphragm comes down, it presses on the organs in the belly, so the belly swells up with each deep breath.

Breathing out, in quiet breathing, is done chiefly by the weight of the chest and the elastic recoil of the muscles. The ribs are lifted up when the intercostals contract, and when these muscles relax, the ribs fall back again to their original position. The fibres of the diaphragm lengthen, and they relieve the pressure on the belly organs; these have been pressed against the belly muscles, and they have stretched and returned to their original position when the pressure is taken off. This is assisted by the internal intercostal muscles, which

are so attached that when they contract they do not lift the ribs, but draw them down. In addition, there are the belly muscles, running from the ribs to the pelvis, and when they contract they press firmly on the belly organs, and so force up the diaphragm.

After running, or when one is short of breath from any reason, other muscles can be made to help breathing. There are muscles which run from the neck to the upper ribs, called the *scalenes*, there are muscles running from the base of the skull to the breast-bone, called the *sterno-mastoids*, and others running from the chin to the upper end of the windpipe. These contract when one is short of breath and help to raise the ribs. Finally, by resting one's elbows on the arms of a chair one can use the muscles running from the shoulders to the ribs and help to expand the ribs in that way.

The nerves to the diaphragm are called the *phrenics*. They are made up of branches of the third, fourth and fifth cervical nerves on each side. The intercostal muscles are supplied by the dorsal nerves.

We have seen how the cavity of the chest can be made larger or smaller, like a bellows.

The lungs might be attached directly on to the chest wall, but their air balloons are very thin, and would be very liable to be torn when the muscles contracted suddenly. The *pleura*, a complete air-tight bag, containing nothing but a little fluid, is placed in between.

How the Lungs are Protected

The pleura is a serous membrane like the pericardium; there is a separate one for each lung. Like the pericardium, each is a bag which lines one half of the chest, and covers the lung on the same side. The inside of the pleura is smooth and lubricated, and the lung can move without sticking.

The lung is elastic and is always trying to collapse, and it is the pleura and its empty bag that keeps it up against the chest wall. If the chest is wounded and a hole made in the pleura, air enters the pleura, and the lung collapses.

Air can only enter the chest through the windpipe. The lung changes its position a little with regard to the chest wall.

In ordinary breathing, in a grown-up person at rest, about 15 to 20 breaths are taken every minute, about one breath for every four heart-beats, with a regular movement of the chest. Expiration takes a little longer than inspiration. The rate of breathing can be increased at will, and must be increased during exercise or excitement. When exercise is taken and more work done by the muscles, they require more oxygen, and the breathing is more rapid in consequence.

The action of breathing is not a voluntary movement; most of the time we are breathing unconsciously. It is not that the diaphragm has any independent power of rhythmic contraction such as the heart has.

Breathing is kept going by a special part of the brain called the *medulla*, where there is a spot called the *respiratory centre*. Impulses go out from this spot, which travel down the cord and leave it by the phrenic nerves and others which supply the breathing muscles. Carbon dioxide is always being produced in the body, and actuates the respiratory centre.

Functions of the Respiratory System

When the blood is exposed to the air in the lungs the hæmoglobin *combines* with the oxygen present; the oxygen is not dissolved in the blood, it is actually combined with the red colouring matter of the blood corpuscles, as oxygen is combined with carbon in carbon dioxide, but the combination is not nearly so firm, and can easily be broken up by anything with a strong affinity for oxygen.

In the tissues there is a great demand for oxygen to combine with the carbon of the muscles, and in them the hæmoglobin of the blood readily gives up its oxygen. Oxygen, then, is carried in the blood in combination with hæmoglobin.

Carbon dioxide is carried in the blood combined with sodium as sodium carbonate, and there is also in the blood a salt called sodium phosphate. In the tissues, carbon dioxide is constantly being produced, and the more there is of it the more sodium carbonate and the less sodium phosphate there is in the blood. But when the blood comes round to the lungs some of the carbon dioxide is given up to the air there, and the sodium thus set free combines again with the phosphoric acid. There is a struggle constantly going on in the blood between the carbonic and phosphoric acid for the sodium.

The functions of the respiratory system are, therefore, to expose the blood to air in the lungs, and this air is regularly changed. In the lungs the blood takes up oxygen by combination with hæmoglobin, and gives up carbon dioxide, which comes to the lungs combined with sodium as sodium carbonate. On exposure to the air part of the carbon dioxide escapes, and the sodium so freed combines with phosphoric acid to form sodium phosphate. D. W. C.-J.

Continued from page 161.

LANGUAGES:

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LATIN.—XXXII

QUESTIONS are of two kinds—simple, and double or alternative. The former asks for a statement on a single point; the latter inquires which of two alternatives is true.

Simple Questions

Simple questions are usually introduced by an interrogative pronoun, adjective, or adverb, such as **quĭs,** *who?* **quŏt,** *how many?* **ŭbĭ,** *where?* or one of the interrogative particles, **-nĕ nonnĕ,** or **num.**

(*a*) The enclitic **-nĕ** is used indifferently with questions anticipating either affirmative or negative replies, thus :—

Vidistine hanc urbem ? *Have you seen this city?*

(*b*) **Nonnĕ** is used when an affirmative answer is anticipated, thus :—

Nonne vidisti urbem incendio conflagrare ?
Do you not see that the city is being destroyed by fire?

(*c*) **Num** introduces questions anticipating a negative, as in :—

Num urbem incendere iussit ?
Did he order the city to be burned?

Alternative Questions

Alternative questions are introduced by **ŭtrum,** sometimes by **-nĕ ;** the alternative or second member by the particle **ăn** :—

Utrum ea vestra an nostra culpa est ?
Is that your fault or ours?
Isne est quem quaere annon ?
Is that the man I seek, or not?

Occasionally no interrogative particle is used with the first member, thus :—

Sunt haec tua verba necne ?
Are these your words or not?

Sometimes what appears to be a simple question is introduced by **ăn,** but on analysis this will usually be found to be really the second member of an alternative question, the first being left unexpressed for rhetorical effect, as in :—

An vero P. Scipio T. Gracchum privatus interfecit ?
Or did P. Scipio as a private person put T. Gracchus to death?

Indirect questions are subordinate clauses forming the subject or object of the verb in a principal sentence, and before considering them we must deal with the whole subject of complex sentences.

Complex Sentences

A complex sentence contains a principal sentence and one or more subordinate clauses or dependent clauses. These dependent clauses may be of a substantival, adjectival, or adverbial nature. Thus a complex sentence may be converted into a simple sentence by substituting a single substantive, an adjective, or an adverb for any dependent clause. Let us now examine these three sorts of clauses in order.

Substantive Clauses may be the subject or the object of the verb in the principal sentence. Such a clause consists of (1) a dependent question, (2) a dependent request or command, or (3) a dependent statement, as in the following examples :—

(1) Unde adveneris rogat.
He asks where you have come from.
(2) Ut ab Italia discedas edicit (*or* orat).
He commands (or *requests*) *you to depart from Italy.*
(3) Ciceronem oratorem fuisse dicit.
He says that Cicero was an orator.
Constat Caesarem a Bruto occisum esse.
It is certain that Caesar was killed by Brutus.

Adjectival Clauses are connected with the main statement by a relative, as in the sentence already quoted :—

Rosa, quae floret, bene olet.
The rose that flourishes smells sweetly.

A relative clause may be substituted for any adjective, and an adjective for any adjectival clause ; thus the sentence given might be turned into **Rosa florens bene olet,** a single adjective taking the place of the relative clause.

Adverbial Clauses are more various in character, and the different kinds should be carefully distinguished and their uses studied. Like adverbs, they modify the meaning of verbs or adjectives in the principal clause, to which they are connected by subordinating conjunctions. They fall into the following kinds, of which the first five may be grouped together as different varieties of circumstantial clause, since they all express some actual or imagined circumstance conditioning the action of the principal verb :—

(1) Temporal, introduced by **quum,** *when,* **postquam,** *after that,* **sĭmŭl āc,** *as soon as,* etc., indicating the time of the action ; as in :—

Quum omnia fecisset, venit pater.
His father came when he had done everything.

(2) Local, **ŭbĭ,** *where,* **quē,** *whither,* **undĕ,** *whence,* etc., indicating the place, as in :—

Qui nunc it illuc unde negant redire quemquam.
Who now goes thither, whence they say no one returns.

(3) Comparative, **ŭt,** *as,* **quam,** *than,* **quăsĭ,** *as if,* etc., indicating the manner in relation to something else, as in :—

Ut sementem feceris, ita metes.
As you sow, so will you reap.

Te quam es meliorem esse volo.
I wish you to be better than you are.

(4) Causal, **quŏd, quĭă,** *because,* **quŏnĭam,** since, etc., indicating the cause or reason of the action, as in :—

Quod regem occidat, nemo non illum miratur.
Every one admires him for killing the king.

(5) Concessive, **quamvīs, quamquam,** *although,* **tămetsī,** *notwithstanding,* etc., contrasting the circumstances with the action, as in :—

Quamvis sit invitus, tamen iuvare illum conabor.
However unwilling he may be, yet I shall try to help him.

(6) Conditional, **sī,** *if,* **nīsī,** *unless,* stating the condition under which the action is performed, as in :—

Si potero, cras veniam.
I shall come to-morrow, if I can.

(7) Final, **ŭt,** *in order that,* showing the purpose or end, as in :—

Ut haec disceret abiit.
He went away in order to learn this.

(8) Consecutive, **ŭt,** *so that,* showing the result or consequence, as in :—

Fratrem vulneravit ut statim mortuus est.
He wounded his brother so that he died at once.

Having noted the different kinds of dependent clauses, the student must now consider the principles determining the mood, and those determining the tense, of the verb in the dependent clause.

Mood in Dependent Clauses

The verb of a dependent clause is either in the indicative or in the subjunctive mood.

Let us premise by referring to the fundamental difference between the indicative and the subjunctive. The indicative affirms that something did occur, is occurring, or will occur contingently on the occurrence of something else.

The subjunctive mood implies that both the occurrence and the condition are imaginary, hypothetical, or dependent. The student may with advantage recall the principles we have stated as governing the use of the subjunctive in principal sentences, and collate these with the principles governing its use in dependent clauses, which will now be enumerated.

It should be noted that unless a change to the subjunctive is required by the principles set out below, the indicative is retained in the dependent clause, if it would be used were the clause a principal sentence.

The subjunctive is used in dependent sentences of the following kinds :—

(1) Hypothetical sentences, in which the events referred to are regarded not as facts but as mere suppositions. (In this case both the protasis and the apodosis of a conditional sentence have their verb in the subjunctive, as will be further shown later.) Examples :—

Si sapiens fuisset, non mortuus esset.
Had he been wise, he would not have died.

Si valerem, ambulare possem.
If I were well, I could walk.

(2) Final sentences, expressing purpose, as :—

Suscipienda bella sunt ut sine iniuria in pace vivatur.
Wars are to be undertaken in order that we may live peacefully and unharmed.

(3) Consecutive sentences, expressing consequence or result, as :—

Nemo tam bonus est ut nunquam peccet.
No one is so good as never to do wrong.

(4) Circumstantial sentences, comprising temporal, concessive, and causal sentences, whether of an adjectival or adverbial type, as exemplified in the two following sentences :—

Quae quum ita sint, abeundum est mihi.
Since these things are so, I must depart.

Peccasse mihi videor, qui haec fecerim.
I seem to have done wrong, inasmuch as I did this.

(5) Oblique or reported sentences, as :—

Rogavit eos cur tam tarde venissent.
He asked them why they had come so late.
Promisit se venturum esse, si in urbe maneret.
He promised to come, if he remained in the city.

(6) Dependent commands or requests, as :—

Obsecro ut mihi ignoscas.
I entreat that you forgive me.

Exercise 31

Translate into English :—

1. Di omen avertant ! 2. Utinam domi moriamur ! 3. Ne dixeris hoc neve illud. 4. Melius fuit victis parcere. 5. Sic utere tuo ut alieno non laedas. 6. Quum talis sis, utinam noster esses.

Translate into Latin :—

1. We have long been desiring to hear from you. 2. I return home to-morrow. 3. The city at this time was strengthened by three walls. 4. It seemed that he did it unwittingly. 5. Every one hates open flattery. 6. I hope to come to-morrow.

Key to Exercise 29

1. What are you going to do with this man ? 2. I would not prescribe the same thing to all who were suffering from various diseases. 3. Let us therefore give a push to him who is falling and knock down one who is done for. 4. For which reason let us dismiss these men at any rate from the argument. 5. And let us ourselves understand that the sense of love and the affection of friendship are produced by nature, when proof of goodness has been shown. 6. Would you quarrel about dignity with those who have remained in the forum ?

1. Quid Tulliola mea fiet ? 2. Lupus ultro fugiat oves. 3. Illud utinam ne vere scriberem ! 4. Cum a me literas librarii manu acceperis, ne paulum quidem me otii habuisse iudicato. 5. Habuisses enim non hospitem sed contubernalem. 6. Faciam quod vultis ut potero.

Key to Exercise 30

1. Whilst the spirit of the Gauls is keen and swift to enter on war, their mind is weak and utterly lacking in the fortitude required for enduring calamity. 2. Twice since then, out of so many years, so many wars, have the supreme trophies been won : so rare is the chance of this distinction. 3. In obtaining these at any rate men exercised care, but were careless in the choice of friends. 4. But the trial must be made in the actual course of friendship. 5. So much does friendship outstrip judgment, and take away the opportunity of making trial. 6. It is difficult to find men who will undergo these.

1. Augustus ipse, Marcello amisso, vix consolari potuit. 2. Drusum veniam omnibus polliciturum in Africam mittunt. 3. Atrox proelium cum multorum utrimque clade initum est. 4. Veram erga inimicos animi magnitudinem saepe praestitisse dicitur. 5. Duo servi fidelissimi cum literis ad Agrippam missi sunt. 6. Eadem nocte mortui sunt duo illi liberatores patriae clarissimi.

E. A. B.

FRENCH.—XXXII

The Infinitive is an indeclinable verbal noun expressing doing or being in an indefinite manner, and may be the subject or the object of a finite verb, or be governed by a preposition, as in—

Vouloir tromper le ciel, c'est folie à la terre,	*To wish to deceive heaven is folly in men.*
Haïr est un tourment,	*To hate is torture.*
L'ardeur de vaincre cède à la peur de mourir,	*The ardour of conquest yields to the fear of death.*
Au doux tomber du jour,	*At the sweet close of day.*
Vous pensez tout savoir,	*You think that you know everything.*

All prepositions used with verbs, with the exception of **en** (see last lesson), govern the infinitive, thus—

J'ai l'intention de voyager,	*I intend to travel.*
Mon frère cessa de parler,	*My brother ceased speaking.*
Avez-vous jamais pensé à offrir à Dieu toutes ces souffrances ?	*Have you ever thought of offering all these sufferings to God ?*

The following are some of the principal verbs, including most of the impersonal verbs, that require the preposition **de** before an infinitive : **s'abstenir**, *to abstain ;* **s'accuser**, *to accuse ;* **achever**, *to finish ;* **s'aviser**, *to bethink oneself ;* **avoir besoin**, **dessein**, **intention**, etc., *to want, intend,* etc. ; **cesser**, *to cease ;* **commander**, *to command ;* **se contenter**, *to be content ;* **craindre**, *to fear ;* **dire**, *to tell ;* **douter**, *to doubt ;* **s'efforcer**, *to endeavour ;* **empêcher**, *to prevent ;* **s'empresser**, *to hasten ;* **éviter**, *to avoid ;* **s'excuser**, *to excuse oneself ;* **se hâter**, *to hasten ;* **manquer**, *to fail ;* **méditer**, *to intend ;* **négliger**, *to neglect ;* **nier**, *to deny ;* **pardonner**, *to excuse ;* **parler**, *to speak ;* **se passer**, *to do without ;* **permettre**, *to permit ;* **se presser**, *to hasten ;* **promettre**, *to promise ;* **se proposer**, *to propose, intend ;* **recommander**, *to recommend ;* **refuser**, *to refuse ;* **se reprocher**, *to reproach oneself ;* **résoudre**, *to resolve ;* **se souvenir**, *to remember ;* **tenter**, *to attempt.*

The following are some of the more important verbs requiring the preposition **à** before an infinitive : **s'accorder**, *to agree ;* **accoutumer**, *to accustom ;* **aider**, *to help ;* **aimer**, *to like ;* **s'appliquer**, *to apply oneself, to endeavour ;* **apprendre**, *to learn ;* **aspirer**, *to aspire ;* **s'attendre**, *to expect ;* **chercher**, *to endeavour ;* **consentir**, *to consent ;* **coûter**, *to cost ;* **déterminer**, *to resolve ;* **encourager**, *to encourage ;* **en-**

seigner, *to teach*; **exceller**, *to excel*; **exhorter**, *to exhort*; **se fatiguer**, *to weary oneself*; **s'habituer**, *to use oneself*; **se hasarder**, *to venture*; **hésiter**, *to hesitate*; **inviter**, *to invite*; **se mettre**, *to commence*; **s'obstiner**, *to persist*; **s'offrir**, *to offer*; **penser**, *to think, to intend*; **persister**, *to persist*; **se plaire**, *to delight*; **prendre plaisir**, *to take pleasure*; **se préparer**, *to prepare oneself*; **se résigner**, *to be reconciled*; **rester**, *to tarry*; **réussir**, *to succeed*; **servir**, *to serve*; **songer**, *to think*; **tarder**, *to tarry*; **tendre**, *to tend*; **travailler**, *to labour*.

The following verbs require no preposition before an infinitive :—

accourir, *to run to.*	nier, *to deny.*
aimer mieux, *to prefer.*	observer, *to notice, to observe.*
aller, *to go.*	oser, *to dare.*
apercevoir, *to perceive.*	paraître, *to seem.*
assurer, *to assure.*	penser, *to think, to fancy.*
avouer, *to confess.*	pouvoir, *to be able.*
compter, *to intend.*	préférer, *to prefer.*
confesser, *to confess.*	prétendre, *to pretend*, etc.
courir, *to run.*	rappeler (se), *to remember.*
croire, *to believe.*	rapporter, *to report.*
daigner, *to deign.*	reconnaître, *to acknowledge.*
déclarer, *to declare.*	regarder, *to look at.*
désirer, *to desire.*	retourner, *to return.*
devoir, *to be obliged.*	revenir, *to come back.*
écouter, *to hear, to listen.*	savoir, *to know.*
entendre, *to hear.*	sembler, *to seem.*
envoyer, *to send.*	sentir, *to feel.*
espérer, *to hope.*	souhaiter, *to wish.*
faire, *to make.*	soutenir, *to maintain.*
falloir, *to be necessary.*	valoir mieux, *to be better.*
imaginer (s'), *to imagine.*	venir, *to come.*
laisser, *to let, to suffer.*	voir, *to see.*
mener, *to take, to lead.*	vouloir, *to be willing.*

Examples :—

J'ai laissé tomber mon couteau,	*I have dropped my knife.*
J'ai entendu dire cela,	*I have heard that said.*
Je la vois travailler,	*I see her working.*
Il ne peut pas venir,	*He cannot come.*
Je prétends vous traiter comme mon propre fils,	*I intend to treat you as my own son.*

Note that the English phrase *go and do*, etc., is rendered into French by the verb **aller** and an infinitive, thus—

Go and fetch my father,	Allez chercher mon père.

The English infinitive following verbs of desiring, commanding, etc., is rendered by the subjunctive, thus—

I wish you to speak to him,	Je veux que vous lui parliez.
I wanted him to sing,	Je désirais qu'il chantât.

The indicative is used after **croire**, *to believe*, and **penser**, *to think*, thus—

I believe him to be unhappy,	Je crois qu'il est malheureux.

The English passive infinitive is usually rendered by an active infinitive in cases like the following :—

Cette dame est bien à plaindre,	*That lady is much to be pitied.*
Cette maison est à vendre,	*This house is to be sold.*
La chose est de trop peu de conséquence pour la traiter sérieusement,	*The matter is of too little importance to be treated seriously.*

Miscellaneous Idioms.—The following idioms may be noted with profit :—

Épouser, marier, *to marry*, differ in meaning. The active verb **marier** can have for its subject only the person performing the ceremony or giving one of the parties in marriage. **Épouser** has for its subject one of the contracting parties, and is followed by a direct object. The reflexive **se marier** or the passive **être marié** take as subject one or both of the contracting parties, thus—

Il a marié sa fille avec M. G.,	*He has married his daughter to Mr. G.*
Il a épousé la fille de M. G.,	*He has married Mr. G.'s daughter.*
M. G. et Mlle L. sont mariés,	*Mr. G. and Miss L. are married.*
Mon frère va se marier,	*My brother is going to be married.*

Avoir beau answers to the expression *it is in vain for you to*, as in—

Vous avez beau dire, il ne viendra pas,	*Say what you like (it is useless to speak), he will not come.*

Other idioms may be studied in the following phrases and sentences :—

Cette dame a l'esprit juste,	*That lady has a correct mind.*
Ces dames ont l'esprit juste,	*Those ladies have correct minds.*
Votre sœur a les yeux noirs,	*Your sister has black eyes.*
Ces garçons se sont fait mal à la tête,	*Those boys have hurt their heads.*
Votre ami a épousé une de mes amies,	*Your friend has married a friend of mine.*
Ils se mirent à pleurer,	*They began to weep.*
Mettre pied à terre,	*To alight, to land.*
Mettre à la porte,	*To turn out of doors.*
Mettre à même de,	*To enable.*
Nous l'avons mis à même de connaître la vérité,	*We enabled him to know the truth.*
Votre sœur tarde bien à venir,	*Your sister is very long in coming.*
Il me tarde de la voir,	*I am longing to see her.*
Il fait jour ; il fait nuit,	*It is daylight ; it is night.*
Il fait de la boue ; il fait de la poussière,	*It is muddy ; it is dusty.*
Il fait bon ici ; il fait cher ici,	*It is comfortable here ; it is dear here.*

Nous avons fait vingt milles à cheval,	*We travelled twenty miles on horseback.*
Cela ne fait rien,	*That does not matter at all.*
Qu'est ce que cela nous fait ?	*What is that to us ?*
Cela ne me regarde pas,	*That is not my business.*
Le feu, est-il à la maison ?	*Is the house on fire ?*
Il n'y a point de feu sans fumée,	*There is no smoke without fire.*
Je fais de mon mieux,	*I am doing my best.*
Il a fait fausse route,	*He has taken the wrong road.*
Voilà midi qui sonne,	*The clock is striking twelve.*

Key to Exercise 55

1. He is less idle and obstinate than his brother. 2. There would not be so much trouble and misery in the world. 3. This bookseller has many good and many bad books in his shop. 4. Heaven does not regulate things according to our wishes. 5. Esteem is the true principle of consideration, which is not always attached to offices. 6. Kings are by no means protected by laws. 7. I cannot suffer that a single one of their vessels should perish. 8. She durst not re-enter her apartment. 9. He who lives hated by all cannot exist long. 10. Liberty ceases not to be worthy of love. 11. No one is happy, unless he can esteem himself. 12. He is more modest than he appears. 13. I am afraid that a dream is deceiving me. 14. The rain prevented their taking a walk in the garden. 15. He does not speak otherwise than he acts. 16. He is not more modest than he appears. 17. Eloquence is a very important art, destined to instruct, to repress the passions, to correct manners, to support the laws. 18. I give you this for you and your brother. 19. He wastes his youth in effeminacy and voluptuousness. 20. He came here lest he might be seen.

Key to Exercise 56

1. Où est votre frère ? Il est ici. 2. Il nous a bien reçus. 3. Votre frère s'est blessé hier. 4. Il n'a jamais dit cela. 5. Je ne chante guère. 6. L'ambition n'a guère de limites. 7. Personne n'aime à recevoir de conseils. 8. Un méchant ne sait jamais pardonner. 9. Je ne puis pas y aller. 10. Je puis ne pas y aller. 11. Il n'ose pas le dire. 12. Il est assez insolent pour ne pas le dire. 13. De peur qu'on ne vous trompe. 14. Il est tout autre qu'il n'était. 15. Il parle autrement qu'il n'agit. 16. Il ne parle pas autrement qu'il agit. 17. Je crains qu'il ne vienne pas. 18. J'ai peur que mon frère n'arrive pas. 19. Il s'assit après avoir parlé. 20. Je suis content de vous voir.

Key to Exercise 57

1. Do you think that you will succeed in this affair ? 2. I would not affirm that it should be written. 3. Command me to depart this very moment. 4. Thou wishest that for thy sake we may believe in impossibilities. 5. It is time that you started for Rome. 6. It does not please me that you should go there. 7. Although I can scarcely sustain my misfortunes, I would rather bear than deserve them. 8. It is not necessary for you to finish that history. 9. In case you persist, I must mention your ill-health to the prince and even to the king. 10. He behaved very ill, so that he was obliged to withdraw. 11. Behave in such a way that people may be pleased with you. 12. Since we plead, die, and become sick, we must have physicians, we must have lawyers. 13. If you go and wish to take me with you. 14. Be good to-day, since thou yet livest.

Key to Exercise 58

1. Il est juste que vous payiez ce que vous avez emprunté. 2. Il est bien fâcheux qu'il se soit oublié ainsi. 3. Je resterai jusqu'à ce que vous ayez réglé vos affaires. 4. Pensez-vous que ce drap dure longtemps ? 5. Je crois que notre portier ne tardera pas. 6. Croyez-vous que ces étudiants puissent apprendre cinq pages par cœur en deux heures ? 7. Je crois que c'est impossible. 8. Pensez-vous que ce négociant s'enrichisse à nos dépens ? 9. Je sais qu'il s'enrichit aux dépens d'autrui. 10. Pensez-vous que le concert ait lieu aujourd'hui ? 11. Je crois qu'il n'aura pas lieu. 12. Voudriez-vous que j'achetasse un habit à demi usé ? 13. Je voudrais que vous en achetassiez un neuf.

Key to Exercise 59

1. Like a golden lamp suspended in the azure, the moon poises herself at the confines of the horizon. 2. Her softened rays sleep on the grass. 3. Being tired, I am going to bed. 4. The rights that your sister has arrogated to herself. 5. I have warned them of it. 6. You have informed them of it. 7. The more enemies he has had, the more he has conquered. 8. The little fortune that I have acquired is enough for me. 9. I do not regret the trouble that work has cost me. 10. The honours that his conduct procured him. 11. Quiet and concealed enmity is more to be feared than open and declared hatred. 12. The iron is blunted ; the pyres are extinguished. 13. Unobtrusive virtue is often despised. 14. When he saw the urn in which the ashes of Hippias were deposited, he shed a torrent of tears. 15. The best orations are those that the heart has dictated. 16. It is truth itself that has dictated to him those fine words. 17. The gods have attached almost as many misfortunes to liberty as to servitude. 18. They abused each other. 19. The privileges that the queen had arrogated to herself caused general dissatisfaction. 20. It was a year since the prince had arrogated those rights to himself.

Key to Exercise 60

1. Ma cousine est-elle aussi obligeante que la vôtre ? 2. Elle est aussi obligeante, et bien plus charmante que la mienne. 3. Vos enfants sont-ils prévenants ? 4. Mes enfants, prévenant tous mes besoins, ne me laissent rien à désirer. 5. Lisez bien attentivement les pages suivantes. 6. Ces demoiselles, suivant l'exemple de leur mère, s'appliquent à la lecture. 7. Qu'avez-vous laissé tomber ? 8. J'ai laissé tomber ma plume ; le pointe en est émoussée. 9. Savoir nager est utile. 10. Le manger est nécessaire à tous les animaux. 11. Ma mère est sortie. 12. Mes tantes sont arrivées. 13. Leurs fils sont devenus grands. 14. Sa grand'mère est morte hier. 15. J'ai reçu votre lettre. 16. Cette femme s'est rendue malheureuse. 17. L'indiscrétion que nous sommes reprochée. 18. Voici la dame que vous avez entendue chanter. 19. Voici la chanson que vous avez entendue chanter. 20. Vous avez entendu une dame chanter ; la voici.

E. A. B.

RUSSIAN.—XXI

The Preposition—*Continued*

226. The Preposition въ, *in, into,* governs:

(*a*) The Accusative, in answer to the question, where to?

(*b*) The Prepositional, in answer to the question, where?

(*c*) The Nominative of Plural, when denoting the taking up of some conjoint calling or pursuit.

Examples

Онъ уѣхалъ въ Ло́ндонъ.	*He has gone to London.*
Мы встрѣтимся въ Ло́ндонѣ.	*We shall meet in London.*
Онъ поступи́лъ въ солда́ты.	*He has enlisted.*

227. The preposition въ finds extensive application in various other ways, as exemplified below:

A—*Full Sentences*

Я жела́лъ бы вступи́ть съ Ва́ми въ торговыя сноше́нія.	*I should like to enter into business relations with you.*
Мы уже состои́мъ въ торго́выхъ сноше́ніяхъ съ друго́й фи́рмой въ Ва́шемъ го́родѣ.	*We already have business relations with another firm in your town.*
Вы пра́вы въ э́томъ отноше́ніи.	*You are right in this respect.*
Нашъ кліе́нтъ ста́вить ни во что́ на́ши усло́вія.	*Our client ignores our arrangements* (terms, conditions).
Этотъ това́ръ тепе́рь въ большо́мъ ходу́.	*This article* (merchandise) *is going very much now.*
Въ кото́ромъ часу́ бу́дете свобо́дны?	*At what time will you be at liberty?*
Фи́рма Д. обвиня́ется въ зло́стномъ банкро́тствѣ.	*The firm D. is being accused of fraudulent bankruptcy.*
Какъ прово́дите вре́мя въ зи́мнія но́чи?	*How do you spend the time in the winter nights?*
Мы игра́емъ въ ка́рты.	*We play cards.*

B—*Short Terms*

О́пытность въ дѣлахъ,	*business experience.*
Знато́къ въ иску́сствѣ,	*a connoisseur of art.*
Въ мо́дѣ,	*in fashion.*
Вѣра въ лю́дяхъ,	*trust in men.*
Сѣсть въ ваго́нъ,	*to take a seat in a carriage.*
Окра́сить въ си́ній цвѣтъ,	*to dye blue.*
Въ знакъ па́мяти,	*as a token of remembrance.*
Въ награ́ду за заслу́ги,	*as a reward for merit.*
Въ оди́нъ день, часъ, мѣсяцъ, годъ,	*in one day, hour, month, year.*
Въ одну́ мину́ту, секу́нду, ночь, недѣлю,	*in one minute, second, night, week.*
Въ концѣ́, нача́лѣ зимы́ и проч,	*at the end, beginning of winter,* etc.
Въ Январѣ́, Февралѣ́ и проч,	*in January, February,* etc.
Во времена́, въ дни . . .	*in the times, days of . . .*
Во́время,	*in the right time.*
Во вре́мя . . .	*at the time of . . .*
Въ пе́рвый, послѣ́дній разъ,	*the first, last time.*
Въ э́томъ смы́слѣ,	*in this sense, meaning.*
Быть въ си́лахъ,	*to have the power, means, strength.*
Не быть въ си́лахъ,	*not to have the power,* etc.
Въ одно́мъ го́лосъ,	*as one man, unanimously.*
Записа́ться въ купцы́, чле́ны,	*to become a merchant, member.*
Въ шу́тку, насмѣ́шку,	*as a joke.*
Въ возмѣ́здіе, отмще́ніе за . . .	*in compensation, revenge for . . .*

228. The Preposition на, *on, upon,* governs:

(*a*) The Accusative, in answer to the question, where to?

(*b*) The Prepositional, in answer to the question, where?

Examples

Я былъ на по́чтѣ.	*I was in the post office.*
Отнеси́ э́то на по́чту.	*Take this to the post office.*

229. More extensive applications of the Preposition на are provided by the following examples:

A—*Full Sentences*

Я Вамъ вѣ́рю на слова́хъ.	*I trust your word.*
Бу́демъ разсужда́ть на э́ту те́му.	*We shall have a discussion on this theme* (topic).
Я полага́юсь на Ва́ше обѣща́ніе.	*I rely on your promise.*
Отдаю́ Вамъ э́ти ве́щи на хране́ніе.	*I leave these things with you to keep them for me.*

B—*Short Terms*

Отвѣ́тъ на телегра́мму, письмо́ и проч,	*an answer to a telegram, letter, etc.*
На часъ, день, мѣсяцъ, годъ,	*for an hour, day, month, year.*
На мину́ту, недѣ́лю,	*for a minute, week.*
На дняхъ,	*these days.*
На лѣ́то, зиму́, о́сень, весну́,	*for the summer, winter, autumn, spring.*
На Рождество́, Но́вый Годъ, Свяну́ю Па́сху,	*for Christmas, the New Year, Easter.*
На бѣ́ду,	*unfortunately.*
На слу́чай,	*in case of, providing for the case.*
На сча́стье, на авось,	*at random.*
На моё сча́стье,	*I was lucky.*
На кредѝтъ,	*on credit.*
На бу́дущее вре́мя,	*for the future.*
На э́то, на то,	*to this, to that.*
На дѣ́лѣ,	*in fact.*
На са́момъ дѣ́лѣ,	*really.*
На па́мять,	*by heart, for remembrance.*
Наоборо́тъ (adverb),	*on the contrary.*
На оборо́тѣ,	*overleaf, on the reverse side.*

230. The Preposition о, объ, *of, about, against,* governs :

(*a*) The Accusative, in answer to the question, against what ?

(*b*) The Prepositional, in answer to the question, of whom, about whom or what ?

Examples

Уда́риться о фона́рь.	*To knock against a lamp-post.*
Говори́ть о дѣла́хъ.	*To speak of business.*

Other examples

Объ э́ту по́ру.	*Approximately, about this time.*
Забу́демъ объ э́томъ.	*Let us forget this.*
Дово́льно объ э́томъ	*Not a word more about this.*

LETTER OF INTRODUCTION

Рекоменда́тельное письмо́.

Ма́нчестеръ, 25 января 1913. г.

Господа́мъ,
Ма́львинъ и Кле́йтонъ

въ С. Петербургѣ.

Ми́лостивые Государи́.

Симъ честь имѣемъ рекомендова́ть Вамъ предъяви́теля сего́, на́шего до́браго знако́маго, г. То́маса Гра́нта, кото́рый намѣревается посѣти́ть главнѣ́йшіе це́нтры Россіи съ цѣлью завя́зыванія тамъ обши́рныхъ торго́выхъ сноше́ній.

Поко́рнѣйше про́симъ Васъ ока́зывать ему́ вся́кое содѣ́йствіе, а гла́вное, руководи́ть его́ Ва́шимъ сове́томъ и о́пытностью въ его́ тру́дной зада́чѣ.

Смѣемъ увѣрить Васъ, что всѣ́ учине́нное Ва́ми въ по́льзу его́ интере́совъ бу́детъ на́ми оцѣ́нено какъ велича́йшая дру́жеская услу́га и, благодаря́ Васъ зара́нѣе за Ва́шу любе́зность, пребыва́емъ, гото́вые къ взаи́мнымъ услу́гамъ,

Съ соверше́ннымъ почте́ніемъ,

Донъ и Бутъ.

NOTES : Предъяви́теля сего́, *bearer of this.* На́шего до́браго знако́маго, *our good friend* (acquaintance). Намѣ́ревается, *intends.* Главнѣ́йшіе це́нтры, *the principal centres.* Съ цѣ́лью завя́зыванія, *with the object of entering into.* Обши́рныхъ торго́выхъ сноше́ній, *large business relations.* Ока́зывать ему́ вся́кое содѣ́йствіе, *to render him every assistance.* А гла́вное, *and above all.* Руководи́ть, *to guide.* Сове́томъ и о́пытностью, *with advice and experience.* Въ его́ тру́дной зада́чѣ, *in his difficult task.* Смѣемъ увѣрить, *we beg* (venture) *to assure.* Всѣ́ учине́нное, *everything done.* Въ по́льзу его́ интере́совъ, *for the benefit of his interests.* Оцѣ́нено, *appreciated.* Какъ велича́йшая дру́жеская услу́га, *as the greatest friendly service.* Благодаря́ зара́нѣе, *thanking in advance.* Гото́вые къ взаи́мнымъ услу́гамъ, *ready for mutual services.*

LETTER OF CREDIT.

Аккредити́въ. Креди́тное письмо́.

Ма́нчестеръ, 25 Января́ 1913 г.

Ру́сскому для Внѣ́шней Торго́вли Ба́нку,

Въ С. Петербу́ргѣ.

Ми́лостивые Госуда́ри.

Симъ честь имѣемъ аккредитова́ть у Васъ предъяви́теля сего́, г. То́маса Гра́нта, на одну́ ты́сячу рубле́й (1000 Руб. Сер.) кото́рые соблаговоли́те выдава́ть ему́, дебету́я нашъ счётъ, въ требуемыхъ имъ су́ммахъ, подъ двойны́ми росписками въ получе́ніи, изъ кои́хъ соблаговоли́те вся́кій разъ препровести́ одну́ къ намъ.

Съ соверше́ннымъ почте́ніемъ,

Lloyds Bank, Limited.

Г. То́масъ Грантъ бу́детъ подпи́сывать :

Grant's signature follows.

NOTES : Аккредитова́ть, *to open a credit.* Выдава́ть ему́, *to pay out to him.* Руб. Сер.=Рубле́й Серебро́мъ, *in silver roubles* (or equivalent in paper money). Соблаговоли́те, *you will be kind enough.* Дебету́я нашъ счётъ, (by) *debiting our account.* Въ тре́буемыхъ имъ су́ммахъ, *in sums required* (demanded) *by him.* Подъ двойны́ми росписками въ получе́ніи, *under double receipts.* Изъ кои́хъ, *of which.* Вся́кій разъ, *each time.* Препровести́, *to forward.*

CIRCULAR LETTER OF CREDIT.

Циркуля́рное (круговóе) креди́тное письмо́.

Ма́нчестеръ, 25 Января́, 1913 г.

Ру́сскому для Внѣ́шней Торго́вли Ба́нку, въ С. Петербу́ргѣ.
Азо́вско-Донско́му Ба́нку, въ Москвѣ́.
Во́лжско-Ка́мскому Ба́нку, въ Ни́жнемъ-Но́вгородѣ.
Ки́евскому Комме́рческому Ба́нку, въ Ки́евѣ.
Ру́сскому Торго́во-Промы́шленному Ба́нку, въ Ха́рьковѣ.

Милости́вые Госуда́ри.

Симъ аккредиту́емъ у Васъ предъяви́теля сего́, г. То́маса Гра́нта, коллекти́вно на о́бщую су́мму Трёхъ Ты́сячъ Рубле́й (3000 Руб. Сер.) съ усло́віемъ произведе́нія упла́ть въ жела́емыхъ получа́телемъ разме́рахъ и отмѣча́нія на сёмъ письмѣ́ выпла́ченныхъ суммъ съ по́дписями выпла́чивающаго ба́нка и г. Гра́нта въ ка́ждомъ отдѣ́льномъ слу́чаѣ.

За произве́денныя упла́ты благово́льте дебетова́ть нашъ счётъ подъ увѣдомле́ніемъ.

Съ соверше́ннымъ почте́ніемъ,

Lloyds Bank, Limited.

NOTES : Азо́вско-Донско́й Банкъ, *Azov-Don Bank.* Во́лжско-Ка́мскій Ба́нкъ, *Volga-Kama Bank.* Ки́евскій Комме́рческій Банкъ, *Kieff Commercial Bank.* Ру́сскій Торго́во-Промы́шленный Банкъ, *the Russian Commercial and Industrial Bank.* Коллекти́вно, *collectively.* На о́бщую су́мму, *for the general sum.* Съ усло́віемъ, *under the condition.* Произведе́нія упла́ть, *handing*

out the payments. Въ желѣемыхъ получа́телемъ размѣ́рахъ, *in sums* (instalments) *as desired by the receiver* (payee). Отмѣ́чанія, *annotation.* Выпла́ченныхъ суммъ, *the sums paid out.* Въ ка́ждомъ отдѣ́льномъ слу́чаѣ, *in every individual case.* Подъ увѣ́домле́ніемъ, *under advice.*

Key to Exercise 22

1. I have a small order for you for some pieces of blue and black serge. 2. I have sent you yesterday under separate cover my best samples. 3. I require more money than you have sent me. 4. I shall send you five hundred roubles more in a fortnight. 5. Could you not oblige me meanwhile with a short-dated bill of exchange? 6. I do not like to sign bills. 7. Please do not refuse. You will render me by this a great service. 8. You are putting me into a very awkward position. 9. Do you require my bill for discounting at the bank? 10. Just so. I have promised my banker to pay in a nice sum on my account during this week. 11. In such a case I shall send you in a couple of days a telegraphic draft. 12. Can you let me have the velveteens now any cheaper? 13. It depends on the volume of the order. 14. I shall order a thousand full pieces. 15. In such a case I shall allow you two per cent. more (of) discount. 16. This is insufficient. I reckoned at the least on five per cent. 17. I shall give you five per cent. if you take not less than three thousand pieces. 18. All right. I agree to that. But do not keep back (detain) the goods, but (= and = a) send them off the quickest possible. 19. I assure you that your order will be executed in the most accurate and speedy manner. 20. Very well. We shall see. You will receive then a new order.

Key to Exercise 23

1. Я получи́лъ Ва́ши новѣ́йшіе обра́зчики и я намѣ́реваюсь купи́ть одну́ ты́сячу кусково́въ чёрнаго сукна́. 2. Сообщи́те мнѣ по телегра́ммѣ Ва́ши крайнѣ́йшія цѣ́ны и вре́мя доста́вки. 3. Я не жела́ю креди́та, но полови́на отпра́вки должна́ быть по́слана свобо́дно. 4. Неме́дленно по осмотрѣ́ніи мно́ю това́ра и нахожде́ніи его́ въ поря́дкѣ я пришлю́ Вамъ оста́токъ нали́чными. 5. Я получи́лъ Ва́ше уважа́емое письмо́ и благодарю́ Васъ за запро́съ. 6. Я телегра́фировалъ Вамъ: „Ста́рыя цѣ́ны безъ переме́ны, отпра́вка два мѣ́сяца.“ 7. Я подтвержда́ю вышеска́занную телегра́мму и наде́юсь, что найдёте для себя́ вы́годнымъ воспо́льзоваться мои́мъ предложе́ніемъ. 8. Могу́ увѣ́рить Васъ, что не бу́ду жалѣ́ть трудо́въ, да́бы удовлетвори́ть Васъ во всѣ́хъ отноше́ніяхъ. 9. Я благодарю́ Васъ за любе́зный зака́зъ и перево́дъ на (въ) пятьсо́тъ фу́нтовъ, которые я записа́лъ на кре́дитъ Ва́шего счёта. 10. Мнѣ о́чень прія́тно Васъ увѣдоми́ть, что я получи́лъ Вашъ това́ръ на про́шлой недѣ́лѣ въ са́момъ лу́чшемъ поря́дкѣ. 11. По́слѣ дне́вной рабо́ты я обыкновѐнно иду́ на прогу́лку. 12. Зи́мній сезо́нъ лу́чше для торго́вли, чѣ́мъ лѣ́тній. 13. Мой ба́нковый счётъ вполнѣ́ удовлетвори́тельнъ. 14. Э́та фи́рма по́льзуется хоро́шимъ и́менемъ. 15. Я не придаю́ значе́нія ло́жнымъ слу́хамъ. 16. Но́выя мо́ды вы́йдутъ въ бу́дущій мѣ́сяцъ.

Key to Exercise 24

1. I should be glad to enter into business relations with you, if you could grant me credit on long terms. 2. The right was given me to allow only three or four months' credit. 3. Any deviation from this rule could only be permitted by the headquarters. 4. I am very much interested in your firm, and I shall make representations about you to my headquarters. 5. Could you not order from me meanwhile something for cash? 6. I shall make exceptional prices for you, which will give you the possibility of getting the upper hand over your competitors. 7. The cheapness of prices is no bait for me at all, and competition does not frighten me. 8. I want only two things: good wares and long terms. 9. What do you understand by long terms? 10. From nine to fifteen months. 11. I hear for the first time of such terms. 12. Our manufacturers are selling their goods from fair to fair. 13. That means just twelve months, and with a bad harvest eighteen months and more. 14. On the very same terms I sell the goods also to my customers. 15. I never inconvenience my customers with regard to money or goods. 16. Therefore they stick to me and will not go over to another firm at any price. 17. Could you explain the reason of such long credits? 18. Ours is an agricultural country. The consumers get goods during the whole year without pay, and settle the bulk after the harvest. 19. And if the harvest happens to be a bad one? 20. Then you are driven to the necessity of waiting for the debt another year and giving the consumer fresh credit.

Key to Exercise 25

1. Е́сли мой зака́зъ ещё не отосла́нъ, не могли́ бы Вы прибавить къ нему́ ещё де́сять кусково́въ сукна́ F.? 2. Вашъ това́ръ былъ отосла́нъ на про́шлой недѣ́лѣ. 3. Сдѣ́лайте отпра́вку въ два́дцать пять кусково́въ и наложи́те плате́жъ на полови́ну сто́имости че́резъ ба́нкъ. 4. Вашъ ве́ксель, сро́чный пе́рваго Февраля́, былъ мно́ю пере́данъ Петроградскому Купе́ческому Ба́нку на инка́ссо. 5. Мы вы́ставили на Васъ перево́дъ на пятьсо́тъ рубле́й. 6. Отзови́те перево́дъ; и́наче онъ бу́детъ неопра́данъ. 7. Я не предви́жу возмо́жности оправда́ть мой ве́ксель, кото́рый сро́ченъ че́резъ мѣ́сяцъ. 8. Вашъ ве́ксель мно́ю отсро́ченъ на три мѣ́сяца. 9. Благодарю́ Васъ за отсро́чку. 10. Вашъ това́ръ полуи́лся съ поврежде́ніемъ. 11. Я его́ оста́вилъ на Ваше распоряже́ніе. 12. Мы не мо́жемъ быть отвѣ́тственны за случи́вшееся въ пути́. 13. Това́ръ былъ вы́сланъ за Вашъ со́бственный счётъ и рискъ. 14. Тѣмъ не ме́нѣе мы не прочь удовлетвори́ть Васъ какъ нибу́дь за уби́тки. 15. Я узна́лъ, что дѣла́ фи́рмы Б. не блестя́щи и по́тому рекоменду́ю Вамъ приними́ать предосторо́жности. 16. Счита́ю своимъ до́лгомъ Васъ увѣ́домить, что Бра́тья Д. обанкро́тились. Причи́на: небре́жное веде́ніе дѣлъ. 17. За Ва́шими интере́сами наблюда́етъ повѣ́ренный М. 18. Судъ объяви́лъ бра́тьевъ Д. злостными банкро́тами. 19. О́ба бра́та аресто́ваны, а иму́щество пере́дано Ко́нкурсному Управле́нію. 20. Говори́тъ, что ихъ пасси́вы превыша́ютъ милліо́нъ рубле́й.

Key to Exercise 26

1. The gentleman who managed our business has become a master for himself. 2. Please send out the order I gave you in three separate shipments (deliveries). 3. The first shipment you may make in February. 4. The number 3517 you have asked for cannot be renewed. 5. Judging by your telegram, I took it for a new order. 6. In looking through your last invoice I found therein two overcharges. 7. Now, on closing up my books, I should be glad (translate: it would be pleasant to me) to receive cover from you. 8. In the barrel figuring on the invoice under No. 269 was discovered a great leakage. 9. The fifty-eighth case has landed quite smashed (broken up). 10. In the sixty gross pencils charged to me was a shortage of five dozen. 11. In examining your newly landed goods I noticed in one of the pieces two big holes. 12. Not being able to sell it, I shall send it you back. 13. I shall send you cover with the first mail that goes out. 14. Taking your explanation into consideration I shall refund to you the losses you have sustained. 15. Considered (considering) from a moral point of view, the way you have acted against your ex-manager was unfair. 16. We have prepared for you a new set, which contains 715 samples. 17. Finding the present market unstable, we decided to keep waiting with our order. 18. Calculating on a near fall of prices, we ask you to secure for us at the first opportune moment forty thousand pounds of Egyptian yarns. A. C.

ITALIAN.—VIII

The Disjunctive Pronouns, used after a preposition or independently, are :—

A, di, per, etc.—	*To, of, for,* etc.—
me	*me, myself.*
te	*thee, thyself.*
lúi (esso)	*him, it* (m.).
ella (essa)	*her, it* (f.).
sè	*himself, herself, itself* (m. or f.).
noi	*us, ourselves.*
voi	*you, yourselves.*
loro (essi)	*them, themselves* (m.).
loro (esse)	*them, themselves* (f.).
sè	*themselves* (m., f.).

All the personal pronouns may be seen in the following table :—

Nominative

	Sing.	*Plur.*
1.	Io, *I*	noi, *we.*
2.	tu, *thou*	voi, *you.*
3.	egli (esso), *he, it* (m.)	églino (essi), *they* (m.).
	ella (essa), *she, it* (f.)	élleno (esse), *they* (f.).

Disjunctive

Sing.

	A, di, per, etc.—	*To, of, for,* etc.—
1.	me	*me.*
	te	*thee.*
	lúi (esso)	*him, it* (m.).
	ella (essa)	*her, it* (f.).

Plur.

	A, di, per, etc.—	*To, of, for,* etc.—
1.	noi	*us.*
2.	voi	*you.*
3.	loro (essi)	*them* (m.).
	loro (esse)	*them* (f.).

Dative-Conjunctive

INDIRECT OBJECT

	Sing.	*Plur.*
1.	Dirmi, *to say to me*	dirci, *to say to us.*
2.	Dirti, *to say to thee*	dirvi, *to say to you.*
3.	Dirgli, *to say to him, it* (m.)	dir (a) loro, *to say to them* (m.).
	Dirle, *to say to her, it* (f.)	Dir (a) loro, *to say to them* (f.).

Accusative-Conjunctive

DIRECT OBJECT

	Sing.	*Plur.*
1.	Vedermi, *to see me*	vederci, *to see us.*
2.	Vederti, *to see thee*	vedervi, *to see you.*
3.	Vederlo, *to see him, it* (m.)	vederli, *to see them* (m.).
	Vederla, *to see her, it* (f.)	vederle, *to see them* (f.).

Conjunctive

DOUBLE : DATIVE AND ACCUSATIVE

	Sing.	*Plur.*
1.	Dármelo (-li, -la, -le), *to give to me it* (or them) (it or them to me)	dárcelo (-li, -la, -le), *to give to us it* (or them) (it or them to us).
2.	Dártelo (-li, -la, -le), *to give to thee it* (or them) (it or them to thee)	dárvelo (-li, -la, -le), *to give to you it* (or them) (it or them to you).
3.	Dárglielo (-li, -la, -le), *to give to him, her, it* (or them) (it or them to him, her)	darlo (-li, -la, -le) (a) loro, *to give to them it* (or them) (it or them to them, m., f.).

Reflexive-Conjunctive

DATIVE

	Sing.	*Plur.*
1.	Darmi, *to give to myself*	darci, *to give to ourselves.*
2.	Darti, *to give to thyself*	darvi, *to give to yourselves.*
3.	Darsi, *to give to himself, herself, itself* (m., f.)	darsi, *to give to themselves* (m., f.).

ACCUSATIVE

	Sing.	*Plur.*
1.	Lavarmi, *to wash myself*	lavarci, *to wash ourselves.*
2.	Lavarti, *to wash thyself*	larvarvi, *to wash yourselves.*
3.	Lavarsi, *to wash himself, herself, itself* (m., f.)	lavarsi, *to wash themselves* (m. f.).

DOUBLE : DATIVE AND ACCUSATIVE

	Sing.	*Plur.*
1.	Dármelo (-li, -la, -le), *to give it* (or them) *to myself*	dárcelo (-li, -la, -le), *to give it* (or them) *to ourselves.*
2.	Dártelo (-li, -la, -le). *to give it* (or them) *to thyself*	darvelo (-li, -la, -le), *to give it* (or them) *to yourselves.*
3.	Dárselo (-li, -la, -le), *to give it* (or them) *to himself, herself,* (m., f.)	dárselo (-li, -la, -le), *to give it* (or them) *to themselves* (m., f).

Reflexive-Disjunctive

	Sing.	*Plur.*
1	A, di, per, etc., me, *to, of, for,* etc., *myself*	A, di, per, etc., noi. *to, of, for,* etc., *ourselves.*
2	A, di, per, etc., te, *to, of, for,* etc., *thyself*	a, di, per, etc., voi, *to, of, for,* etc., *yourselves.*
3.	A, di, per, etc., sè, *to, of, for,* etc., *himself, herself, oneself, itself* (m., f.)	a, di, per, etc., sè, *to, of for,* etc., *themselves* (m., f.).

Vocabulary

qualcosa (qualche cosa), *something.*
straordinário, *extraordinary.*
intiero, intero, *entire, whole.*
último scorso (generally abbreviated to *u. s.*), *last past.*
éccovi, *here is, enclosed* (lit., here to you).
accusare, *to acknowledge.*

lagnarsi, *to complain.*
la lagnanza, *complaint.*
solo, *alone, only.*
per tempo, *early.*
volendo (from *volere*), *wishing.*
al più presto possibile, *as early as possible.*
la cópia, *copy.*
la pólizza, *policy.*
la pólizza di assicurazione, *insurance policy.*
tante volte, *so often.*
infatti, *in fact.*
l'arrivo (m.), *arrival.*
venturo, *next, coming.*
próssimo, *next.*
quanto, *how much, how many.*
il padre, *father.*
il cugino, *cousin.*
cinquecento, *five hundred.*
costituíre, *to constitute.*
precisamente, *precisely, exactly.*
aprile, *April.*
la ricevuta, *receipt.*
riandare, *to look over.*
peranco, *as yet.*
dovuto, *due, owing.*
che, *who.*
méglio, *better.*
il resto, *rest, remainder.*
abbastanza, *sufficient, enough.*
il mese, *month.*
temere, *to fear.*
l'amicizia (f.), *friendship.*
in casa, *at home.*
la presentazione, *presentation.*
la partenza, *departure.*
sorpréndere, *to surprise.*
il risultato, *result.*
la maniéra, *way, manner.*
il consegnatário, *consignee.*
a così dire, *so to say.*
il progetto, *plan, scheme, arrangement.*
la clientela, *custom.*

Exercise 15

Translate into English :—

1. Egli mi dice che gli si è detto qualcosa (qualche cosa) di straordinario. 2. Ci è stata pagata la somma intiera e perciò non vogliamo più lagnárcene. 3. Ciò che era bastato per lúi solo non è bastato per noi quattro. 4. È piovuto tanto che non abbiamo potuto uscire nemmeno per un minuto. 5. Ci siamo alzate (f.) di buon'ora (or per tempo) stamattina, volendo cominciare il nostro lavoro al più presto possíbile. 6. Dov'è (dove è) la cópia della pólizza ? Ve l'ho data, non ve ne ricordate ? 7. Egli non si ricorda di nulla, me l'ha detto lúi stesso tante volte. 8. L'abbiamo detto a loro, a lúi (a esso), a ella (essa) e a voi, ma voi tutti lo dimenticate sempre. 9. Hanno, fatto questo lavoro per me e per voi, infatti per noi tutti, a così dire. 10. Spero vedervi sano e salvo al vostro arrivo qui la settimana próssima (ventura). 11. Quanto tempo érano nella casa, più di tre ore ? 12. Cercavate vostro padre o vostro cugino quando noi eravamo al teatro ? 13. Questo saldo di cinquecento lire italiane costituísce precisamente la nostra fattura del tre aprile u.s. (último scorso).

Exercise 16

Translate into Italian :—

1. Were they here yesterday when we were writing to the customers who had not yet paid their accounts ? 2. Having given you a part of it, we thought it was better to give you the rest of it. 3. What had sufficed for them has not been sufficient for us four. 4. On looking over my books, I find that you have not yet paid the invoices of last month. 5. They feared to (di) lose our custom, and therefore they always executed our orders at favourable prices. 6. Were you not afraid (translate, did you not fear) to (di) find me at home ? 7. When was (has been) the draft presented to you ? 8. It was (has been) presented to us yesterday, and we honoured (have honoured) it on (at the) presentation. 9. Do you know where the insurance policy for this shipment is (translate, where is, etc.) ? 10. They used to store (imperf.) our packages for two or three months before forwarding them to the consignees. 11. We are told (translate, to us it says itself) that the plan is something extraordinary.

Key to Exercise 6

1. Quando siete partiti per Palermo ? 2. Hanno ricevuto alcune léttere dagli stessi avventori (clienti). 3. Dove sono le rimesse che sono venute dai compratori ? 4. Sono lieto d'informarvi che il vostro principale è arrivato stamattina sano e salvo. 5. A che ora è partito per il (pel) teatro ? 6. Il píccolo campione non è di così buona qualità come il grande. 7. È un brutto affare, perciò ho preferito di abbandonarlo (scartarlo). 8. Abbiamo rifiutato le merci perchè i fabbricanti non hanno voluto darci una garanzía. 9. In caso negativo, abbiate la bontà di rifiutare la consegna. 10. Se siete venuti col primo treno, com' è (come è) che siete arrivati così (tanto) tardi ? 11. Avete esaminato i nuovi disegni prima di dare l'ordine ? 12. Ho bisogno di píccoli disegni invece de' grandi che mi avete offerti. I piccoli sono belli, ma i grandi sono brutti. 13. Non parliamo più di quel soggetto spiacévole. 14. (Essi) sono andati da lúi per (*or* onde) spiegargli l'affare. 15. I compratori di alcune importanti case éstere sono arrivati nella città questo dopopranzo. 16. Abbiamo sperato di ricévere alcuni begli órdini da loro. 17. Questi libri sono stati pubblicati dalla migliore casa editrice della città. 18. La pólizza di cárico non ha portato il nome dello spedizioniere. 19. È andato da loro per conversare sull' (circa l') esecuzione degli órdini. 20. Conosco l'uomo che ha scritto la léttera, e gli ho parlato (*or* : e ho parlato con lui).

Key to Exercise 7

1. We have spoken to the lawyer and he has told (related to) us much (a lot) about this matter. 2. Having satisfied all their creditors, they fear nothing. 3. It is necessary to write to the house (firm) and tell them (her) that we cannot transact the business without suffering a considerable loss. 4. I have asked him to remit me a cheque for a hundred pounds sterling, but he has refused. 5. Our book-keeper (accountant) has not yet checked the accounts, says the cashier. 6. We want the key which is in the cashier's desk. 7. Our clerks have finished all their work for to-day. 8. These furs are for the merchant and this money is for the travellers. 9. This morning fifteen letters have arrived (come by the post). 10. He has forwarded by post the amount of the invoice, deducting the discount according to our orders. 11. We have sold the goods for prompt cash, and we cannot wait any longer without losing money. 12. A good friend of mine in your city has favoured me with the name of your esteemed firm. 13. According to the desire (wish) expressed (manifested) to us in your esteemed letter, we have sent various patterns of velveteens and silk to your representatives. 14. We regret (have the displeasure) to have to inform you that the prices are 10 per cent. dearer than usual. 15. Please let me know immediately when we can count upon the payment. 16. I have been able to sell (dispose of) quickly (soon) all your wine, and I have placed the amount of it to your credit. 17. Having had no reply to my letters (lit : my letters being remained without reply) of the 4th instant and 16th ultimo, I beg you to settle my account at once. 18. They are disposed to trust to you their purchase of cotton and furs, but only on the following conditions. 19. My said (above-named) agent at Turin, Mr. Paul Simonetti, has sent (remitted) you my estimate and I hope that you have honoured us with your esteemed orders. 20. We are certain that our representatives have not neglected anything in order to satisfy you, and therefore we are very sorry that you have given (passed) your orders to others.

A. C.

SPANISH.—VIII

Subjunctive Mood (*continued*). — This mood is used in Spanish very much more than in English. For instance, where we say in English : " He wishes you to do that," a Spaniard would prefer to say : " He wishes that you do that," viz. : **Él quiere** (from **querer**) **que V. haga** (3rd Person Singular, Pres. Subj. of **hacer**) **eso.**

It will be observed that as a fixed rule in Spanish the Infinitive cannot be used, unless its subject, implied or understood, is the same as for the verb immediately preceding it. It would be, therefore, quite correct to say : **Él quiere hacer eso,** *He wants to do that*, because the same subject refers to both verbs, but in the previous example we have **él** as the subject of **quiere** and **V.** as the subject of **haga,** so that it would be incorrect to say : **Él quiere V. hacer eso.**

The student's attention has been already called to this rule in the examples of Lesson VII.

The Subjunctive Mood is needed after :—

Principal sentence	*Secondary sentence*
1. Impersonal Verbs	**que** with Subjunctive Mood.
2. Negative Verbs / Interrogative Verbs	
3. Emotional Verbs (see next lesson)	
4. Superlatives	
5. Some Conjugations	

Conjugation of Verbs.—We have still to give the Imperative Mood of the Auxiliary Verb **haber,** *to have*, the principal verb **tener,** *to have* (in the sense of to possess, to hold, etc.).

Imperative Mood

HABER

Affirmative

Sing.	*Plur.*
1. (Not used)	hayamos, *let us have.*
2. hé, *have (thou)*	habed, *have (ye).*
3. haya, *let him have*	hayan, *let them have.*
haya V., *have (you)* (polite sing.)	hayan Vs., *have (you)* (polite plur.).

Negative Imperative is Present Subjunctive, preceded by **no,** omitting first person singular, viz., **no hayas,** *do not have* (thou), etc.

TENER

Affirmative

Sing.	*Plur.*
1. (Not used)	tengamos, *let us have.*
2. ten, *have (thou)*	tened, *have (ye).*
3. tenga, *let him have*	tengan, *let them have.*
tenga V., *have (you)* (polite sing.)	tengan Vs., *have (you)* (polite plur.).

Negative Imperative is Present Subjunctive, preceded by **no,** omitting first person singular, viz., **no tengas,** *do not have* (thou), etc.

Special use of **haber.**—The verb **haber** also serves to designate *existence*, meaning *there to be*, and is then only used in the 3rd Person Singular, as follows :—

habiendo, *there being*	habiendo habido, *there having been.*

Indicative Mood

hay (not **ha** in this instance), *there is, there are*	había, Impf. / hubo, Past Def. } *there was, there were.*
habrá, *there will be*	habría, *there would be.*

Subjunctive Mood

(que) haya, *(that) there may be*	(que) hubiese, *(that) there might be.*
(que) hubiere, *(that) there will be*	(que) hubiera, *(that) there should* or *might be.*

Present Subjunctive.—This tense is formed by adding the endings given in Lesson VII. to the stem of the 1st Person Singular of the Present Indicative of the verb, whether regular or irregular, with the following exceptions :—

Infinitive	*Present Indicative*	*Present Subjunctive*
dar, *to give*	doy, *I give*	dé, des, dé, demos, deis, den.
estar, *to be*	estoy, *I am*	esté, estés, esté, estemos, estéis, estén.
ir, *to go*	voy, *I go*	vaya, vayas, vaya, vayamos, vayáis, vayan.
ser, *to be*	soy, *I am*	sea, seas, sea, seamos, seáis, sean.
haber, *to have*	he, *I have*	haya, hayas, haya, hayamos, hayáis, hayan.
saber, *to know*	sé, *I know*	sepa, sepas, sepa, sepamos, sepáis, sepan.

By way of exercise the student should supply the remaining persons of the Present Subjunctive of the verbs given below :—

Infinitive	*Present Indicative*	*Present Subjunctive*
asir, *to seize*	asgo, *I seize*	asga, etc.
caber, *to be able to be contained (to find room)*	quepo, *I can be contained, find room (in)*	quepa, etc.
caer, *to fall*	caigo, *I fall*	caiga, etc.
decir, *to say*	digo, *I say*	diga, etc.
hacer, *to make, do*	hago, *I make, do*	haga, etc.
oír, *to hear*	oigo, *I hear*	oiga, etc.
salir, *to go out*	salgo, *I go out*	salga, etc.
tener, *to have* (possess, hold, etc.)	tengo, *I have*	tenga, etc.
traer, *to bring*	traigo, *I bring*	traiga, etc.
valer, *to be worth*	valgo, *I am worth*	valga, etc.
ver, *to see*	veo, *I see*	vea, etc.

The following change the root vowel " e " or " o " as follows :—

Infinitive	*Present Indicative*	*Present Subjunctive*
erguir, *to erect*	irgo, *I erect* / yergo, *I erect*	irga, irgas, irga, irgamos, irgáis, irgan. / yerga, yergas, yerga, yergamos, yergáis, yergan.
morir, *to die*	muero, *I die*	muera, mueras, muera, muramos, muráis, mueran.
poder, *to be able*	puedo, *I can*	pueda, puedas, pueda, podamos, podáis, puedan.
querer, *to wish, like*	quiero, *I wish, like*	quiera, quieras, quiera, queramos, queráis, quieran.

Examples

Puede V. contar con que lo hagamos á tiempo (Affirmative sentence. Inversion of verb and subject, as in this case, " Puede V." instead of " V. puede," often takes place in Spanish).

You can count upon our doing it in time.

Ellos quieren los dibujos más bonitos que hay en el mercado (Indicative Mood required after Superlative used in a restricted sense).

They want the nicest designs there are in the market.

Envíenos V. todo lo que haya de conveniente.

Send us everything (all there is of) suitable.

Es de esperar que llegue hoy el vapor.

It is to be hoped that the steamer will arrive to-day.

¡ No digan Vs. que sea diferente !

Do not say it is different !

Aunque vengan hoy los bultos, no puedo aceptarlos.

Though the packages should come to-day, I cannot accept them.

¿ Le parece á V. que vengan hoy ?

Do you think they will come to-day ?

Sentimos en el alma que sea imposible pagar la cuenta durante este mes.

We regret exceedingly (literally, we regret in the soul) *that it is impossible to pay the account during this month.*

VOCABULARY

creer, *to believe* (creo, crees, etc.).
la persona, *the person.*
el ciudado, *the care.*
pronto (adj.), *ready.*
la salida, *the departure.*
menester (adj.), *necessary.*
la calidad, *the quality.*
parecer, *to appear.*
me parece á mí, *it appears to me.*
maravillarse, *to be astonished.*
me maravillo, *I am astonished.*
la mesita (diminutive of mesa), *the little table.*
el rincón, *the corner* (of a room, etc.).
indispensable, *indispensable.*
aproximarse, *to draw near.*
el error, *the error, mistake.*
tampoco, *neither.*
afín que, *in order that, to the end that.*
reconciliarse, *to become reconciled.*
el padre, *the father.*
escoger, *to choose.*
servirse, *to be pleased (to).*
¡ Sírvase V. ! (sírvanse Vs. !), *please !*
¡ Sírvanse V. darme ... ! *Please, give me ...*
á la letra, *to the letter.*
estúpido, *stupid.*
el ruído, *the noise.*
la habitación, *the room*
el cuarto, *the room.*
embalar, *to pack.*
el miedo, *the fear.*
tener miedo, *to be afraid.*
mojarse, *to get wet* (literally, to wet itself, themselves, etc.).
el viaje, *the voyage, the journey.*
presentarse, *to present itself.*
favorable, *favourable.*
concluir, *to conclude.*
la paz, *the peace.*
la posibilidad, *the possibility.*
importar, *to matter.*
me importa á mí, *it matters to me.*
doble (adj.), *double.*
el cañamazo, *the canvas* (Hessian for packing bales).
el destino, *the destination.*
cambiar, *to alter, change.*
la disposición, *the disposition.*
el testamento, *the will.*
el fardito (diminutive of fardo), *the truss.*
la entrega, *the delivery.*
el número, *the number.*
hacer una visita, *to pay* (make) *a visit.*
principal (adj.), *principal.*

Exercise 13

Translate into English :—

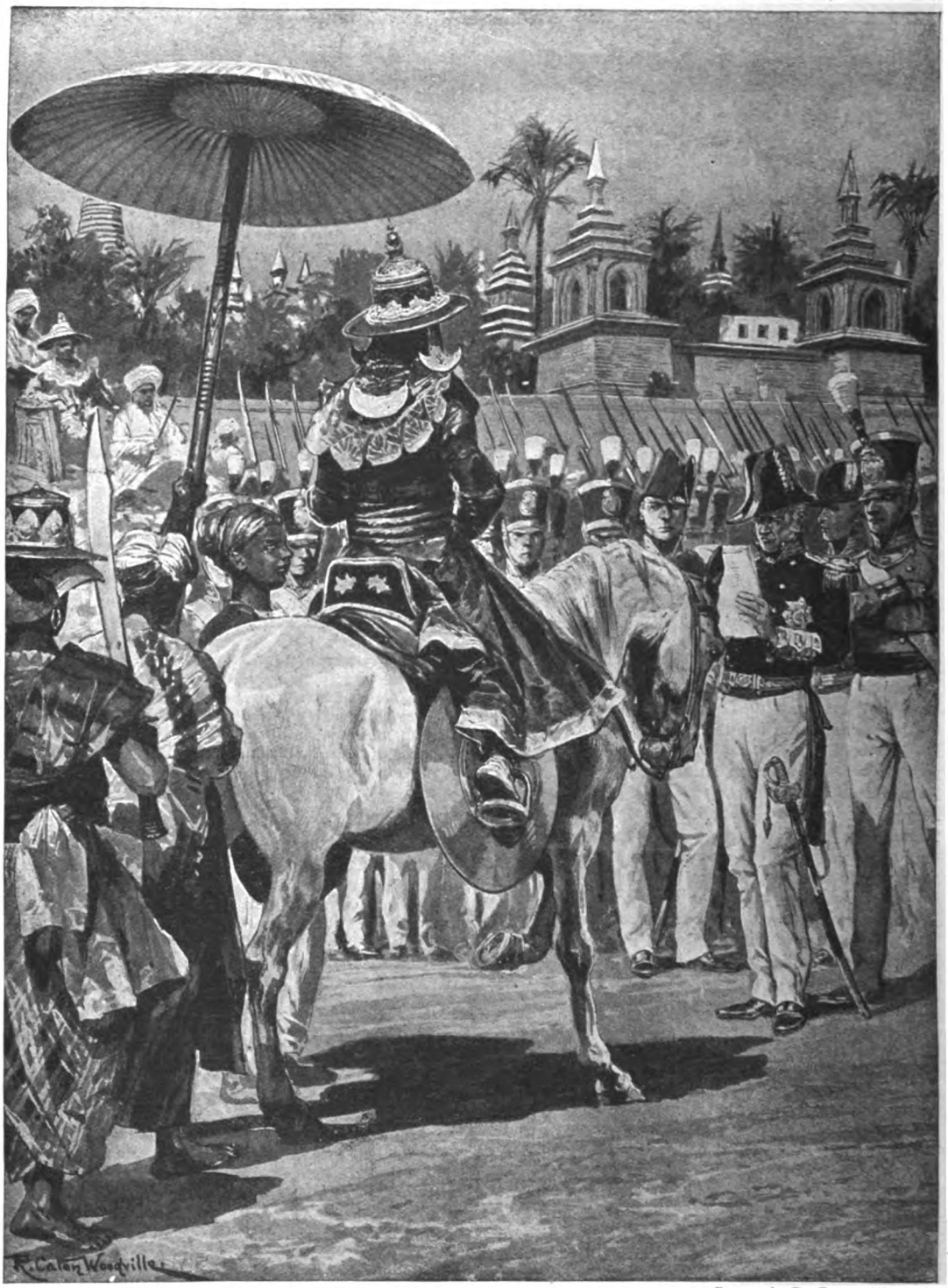
1. Ellos quieren que nosotros escribamos las cartas. 2. Queremos que V. diga la verdad. 3. No creemos que sea el mismo dibujo. 4. ¿ Es posible que haya personas que hagan eso ? 5. ¿ Creen Vs. que sea posible llegar antes de la noche ? 6. Siento en el alma que tengan tan poco ciudado en este asunto. 7. Pueden Vs. contar con que estemos prontos á tiempo para la salida del vapor. 8. Es menester que V. nos dé las mejores calidades que haya en la plaza. 9. Nos maravillamos que no quepa la mesita en este rincón. 10. Este fabricante es el mejor hombre que viva. 11. Estos son los mejores dibujos que tiene el fabricante. 12. Sería indispensable que Vs. embalasen bien los géneros pedidos por miedo de que (or de miedo que) se mojasen durante el viaje. 13. ¡ Esperemos hasta que se presente una oportunidad (or ocasión) más favorable ! 14. Habrá muchos más vapores después de concluida (or después de concluirse) la paz. 15. Antes que V. esté en ésta (i.e. en esta ciudad) no hay posibilidad que hagamos lo que quieren (= Vs.). 16. Que él sepa ó no, poco me importa á mí. 17. ¡ Aproxímese V. á mí para que le oiga á V. mejor ! 18. Le digo á V. esto para que no caiga en el mismo error que yo. 19. Valga lo que valga (or valiere), no lo quiero, ni deseo tampoco que V. lo vea. 20. He dicho todo á mi amigo afín que pueda, si quiere, reconciliarse con su padre antes que muera éste.

Exercise 14

Translate into Spanish :—

1. Bring me all you have (Subj.) and I will choose what is (Subj. of " haber ") suitable (tr. of suitable). 2. I wish you to see the new designs and to tell me what you think about them. 3. Please give us all particulars so that we may be able to follow your instructions to the letter. 4. I do not think it is the same design, but it is possible that the customer will accept it (Pres. Subj.). 5. Do you think it is possible there can be (tr. that there be, from " haber ") persons so stupid ? 6. Please give me the best qualities that you can find. 7. He can count upon my going out before he arrives. 8. It is not possible for me to hear when there is such a noise in the room. 9. Tell me which are the best designs the manufacturer has. 10. It would be indispensable that I should pack the goods in double canvas, for fear they got wet before the shipment reached its destination. 11. It is necessary that they should explain (Pres. Subj.) all to their partner before he dies, so that he may alter the dispositions of his will. 12. Take out these trusses, so that the new deliveries may find room in this corner.

A. C.



Drawn by R. Caton Woodville.

THE SURRENDER OF RANGOON, BURMA, TO THE BRITISH, MAY 11, 1824.

The Burmese Empire, established in the middle of the eighteenth century, grew, under the rule of Alompra, so formidable as to be a serious menace to British influence in India. War became inevitable, and hostilities began in 1824 by the occupation of Rangoon by the British. Two years' hard fighting followed before Sir Archibald Campbell was able finally to bring the Burmese to terms and secure for Britain Assam, Aracan, and the coast south of Martaban.

Continued from page 165.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).

ASIA.—IV

It will be convenient here to interrupt our survey of the main drainage basins of Asia and to discuss first Japan and then the Indo-Chinese peninsula before considering the great southern drainage area of India.

Politically Japan consists of a chain of islands extending from the Kurile Islands, in Latitude 50° N., through the lower half of the island of Sakhalin, Yezo, Japan proper (including Hondo—the chief island—Shikoku and Kyushu), the Loo Choo Islands to Formosa in latitude 22° N. It thus extends through nearly 30° of latitude. Korea (annexed by a treaty between Japan and Korea in 1910) is also subject to Japan.

Japan has a total area of 260,000 square miles and a population of over 77,000,000.

It has a very much indented coast-line, with fine harbours distinguished by very beautiful scenery.

Empire of Japan

The islands comprising the Empire of Japan are very mountainous, and these mountains form part of the volcanic girdle of the Pacific already alluded to. The highest mountain in Japan proper is the now almost extinct volcano Fuji-Yama (12,400 feet), a nearly perfect volcanic cone whose outline is reproduced in wellnigh every form of art, in which Japan is so rich. Although the highest mountain in the main islands, it is surpassed by a peak in Formosa of 14,300 feet.

The country is subject to earthquakes, many of which have caused terrible loss of life and property. It is owing to the prevalence of earthquakes that the houses of Japan are composed of wood and bamboo.

Japan contains very few rivers of any considerable size, the longest, Tonegawa, being only 180 miles in length. Its lakes comprise among lesser ones Lake Biwa, 43 miles long, a beautiful and picturesque sheet of water near Kioto, the former seat of the Emperors

The climate of Japan is temperate, with a rather high rainfall.

The country has a great variety of vegetation, owing to its extension through so many degrees of latitude, and the height and size of the mountains. Evergreen shrubs are very abundant, often bearing beautiful flowers. On the higher ground occur deciduous trees such as elm, beech, birch, chestnut, etc.; lower down bamboo and palms flourish.

Flora and Fauna

Oranges, grapes, apples, pears, peaches, etc., are largely cultivated. Sixty per cent. of the total area is covered by forests, of which one third belongs to the State.

With regard to animals, the largest is the bear, one of which, a small black kind, is peculiar to Japan, the other variety being the grizzly, like that found in N. America. Wild boars, stags, antelopes, badgers, foxes and sea otters abound. The ordinary domestic animals are abundant, and birds comprise pheasants, pigeons, cranes, etc., as well as the eagle, falcon, swallow and jay. There are but few venomous snakes.

Rice is the most important crop; barley and wheat do not flourish, as the country is too damp, but hemp, tobacco, cotton, sugar-cane, tea, the sweet potato, etc., are largely grown.

Japan is not so well supplied with mineral wealth, though coal, copper, gold, silver, iron and sulphur are mined.

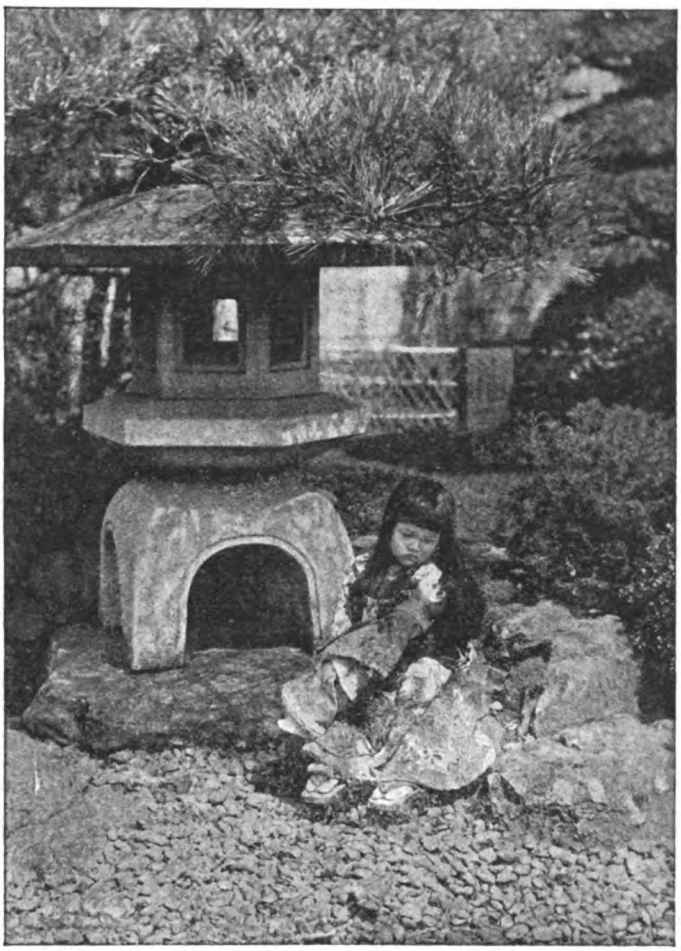
Among manufactures, silk, earthenware and lacquer-ware are important. Paper of a kind made from the inner bark of the mulberry is characteristic of the country.

Japan has a fairly well developed system of railways, most of which belong to the State, and an extensive shipping industry.

Tokio is the capital, with a population of considerably over 2,000,000. There are nearly 40 ports open for foreign trade, the chief being Yokohama, Kobe, Nagasaki, Hakodate, Osaka, etc., the two first named being vastly the most important.

The Japanese are a Mongolian people, and their civilisation is extremely ancient. Since 1868 Western ideas have been adopted with great vigour. The official religion of Japan is Shinto—a kind of nature worship—but there are many Buddhists and Confucians.

In the island of Yezo and the south of Sakhalin, especially, are found the Ainos or Ainus, a people rather European in type, but of small stature and exceedingly hirsute. They are of very dirty habits and are polygamous ; and their total number is now only about 15,000.



A LITTLE JAPANESE GIRL WITH A DOLL.

A picturesque scene in a picturesque land. The Japanese are a Mongolian people, and their civilisation is very ancient ; though since 1868 Western ideas have been adopted with great vigour.

Indo-China is a geographical expression for the country lying south of Assam and the Chinese provinces of Yun-Nan and Kwang-si. It is washed on the east and west by the China Sea and the Indian Ocean ; to the south it is prolonged beyond the isthmus of Kra into the Malay Peninsula. Politically divided, it consists of Indo-China and Malacca, comprising Burma, Siam, Annam, Cambodia, Cochin China, and the Straits Settlements.

Generally speaking, it consists structurally of a number of mountain ranges running roughly north and south attaining elevations of about 5,000 to 6,000 feet high, with rivers between them. Among these ranges are the Aracan Yoma, Pegu Yoma, Shan Yoma, and Tanen Tuang Gyi, separating the basins of the Irawadi, Sittang, Salwin, Mekong, Song Koi, etc. The centre of the southern portion of Siam contains the great alluvial plain of the Menam River.

Burma

Burma is the westernmost of the Indo-Chinese states, and belongs to Great Britain. It is under the control of the Government of India. Burma has an area of over 250,000 square miles, with a population of about 12,000,000.

The chief river is the Irawadi, which occupies the valley between the Aracan and Pegu Yoma mountains and flows into the Bay of Bengal through a huge delta. It is navigable for 900 miles from the sea, and on its banks lies the town of Mandalay, the capital of Upper Burma. The chief ports are Rangoon, the capital of Lower Burma, Maulmain and Aykab.

Burma is very fertile, and rice, wheat, cotton and tobacco are largely grown. One of the chief vegetable products is teak, of which Burma is an important source of supply. Among the animals found are the elephant, rhinoceros, tiger and leopard ; there are many varieties of birds, and in the rivers a great abundance of fish. The mineral wealth of the country is great, and includes petroleum, which occurs on the banks of the Irawadi. Near Mandalay are important ruby mines, and in various parts are found gold, silver and coal, though they have not yet been worked to any appreciable extent.

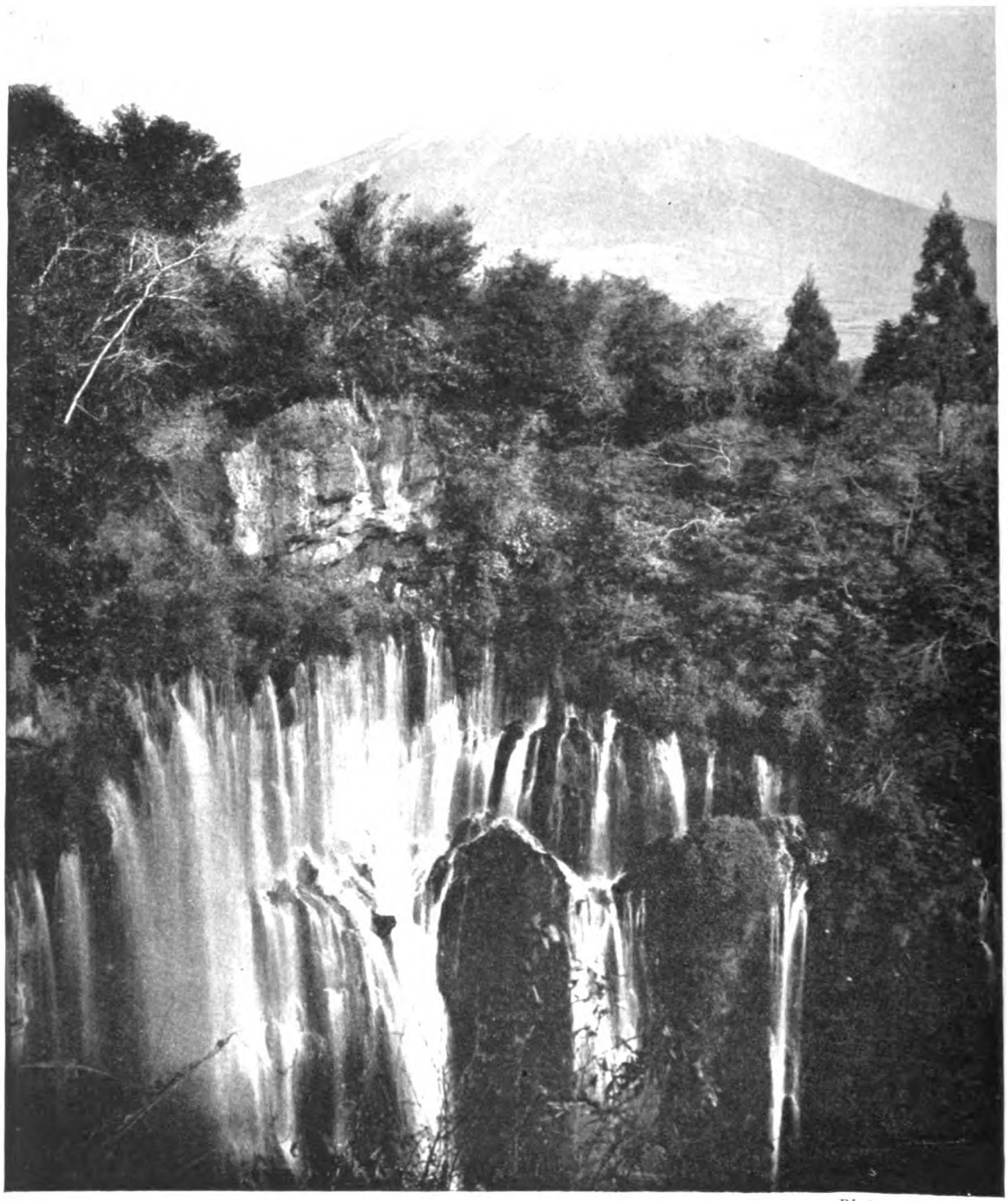
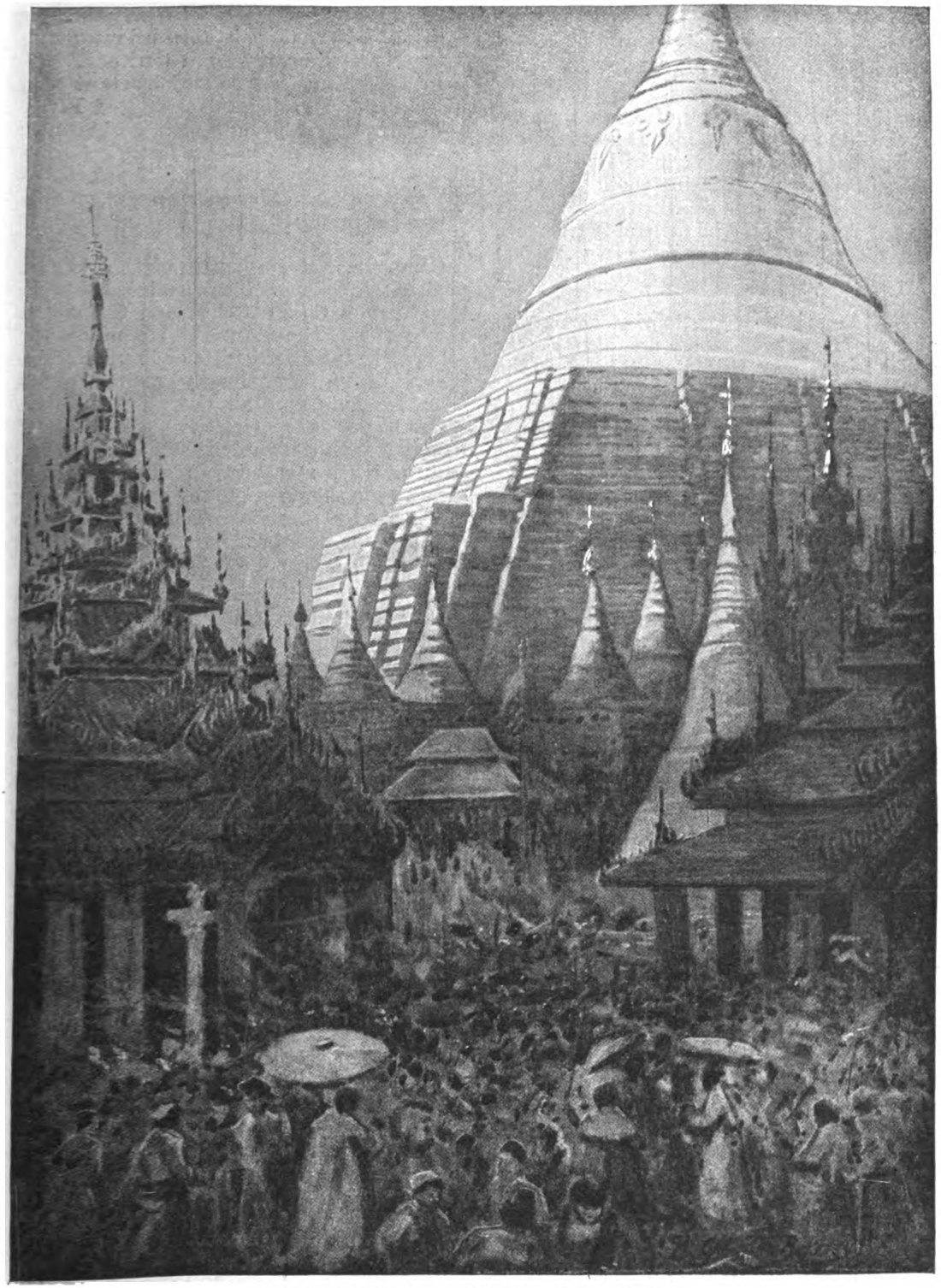


Photo: Record Press.

THE BEAUTIFUL SHIRAITO WATERFALL

at the foot of the almost extinct Japanese volcano, Fuji-Yama (12,400 feet), which in outline represents an almost perfect volcanic cone.



THE SCHWE DAGON PAGODA, BURMA.

Showing a procession to the remarkable shrine, where four hairs from the head of Buddha are said to be preserved in a golden casket.

Siam and Annam

Siam is an independent kingdom lying between the British territory of Burma and the French territory of Annam, to the north of the Gulf of Siam. It also includes Lower Siam, a narrow strip of land on the Malay Peninsula. The northern part is mountainous, but the southern part consists of the fertile and alluvial plain of the Menam. The total area of Siam is nearly 200,000 square miles, and the population is over 8,000,000.

The climate is similar to that of Burma, and the flora and fauna are also closely allied to those of that state. Siam is the largest teak producing country in the world, and the forestry industry is almost entirely in British hands. Of minerals, Siam produces gold, silver, precious stones and tin. This last is chiefly worked on the island of Junk Seylong, on the west of the Malay Peninsula, where the tin mines are very valuable and enormously productive. Rice is the most important article of commerce.

The capital of Siam is Bangkok, a few miles up the River Menam, though vessels of heavy draught cannot pass the bar at the mouth of the river, thus rendering transhipment necessary in the case of the cargoes of large ships.

Annam, together with Tong King, Cambodia and Cochin China, belong to France, or are protectorates of that nation. The total area is some 300.000 square miles, and the population exceeds 16,000,000. The western boundary is generally the great Mekong River, though this below Stung Treng flows through French territory.

In Tong King, rice is an important crop in the delta of the Song Koi, or Red River, two crops a year being generally obtained ; sugar is also an important industry. Cochin China practically consists of the delta of the Mekong and other small rivers, and is extending in size by the alluvium brought down by the streams.

Cambodia consists mostly of the alluvial plain of the Mekong. The climate is healthier than that of Cochin China, and the soil is very fertile. The industries are much the same as in the other states of French Indo-China, sugar being largely manufactured from the fan-palms all over the country.

Cambodia was formerly a powerful kingdom with a high degree of civilisation, and contains many traces of its former greatness in the shape of the ruins of Angkor Wat, near the great lake Tonle Sap, in the north of the country.

Straits Settlements

The Straits Settlements is a British Crown Colony situated at the extreme end of the Malay Peninsula, and comprises besides this various native states under British protection and a few other islands. Singapore is the capital, and although the population is under 1,000,000, the trade is very large, tin being accountable for about a quarter of the exports.

The whole of the country is extremely fertile and well wooded, and is very rich in minerals of all kinds. C. J. S.

Photo: F. O. Koch.

A CHINESE DOCTOR WITH HIS CLIENTS

at Singapore, the populous capital of the Straits Settlements, a British Crown Colony situated at the extreme end of the Malay Peninsula.

Continued from page 169.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

MECHANICS.—XI

64. *To find the magnitude of the resultant of two forces acting at a point at right angles to one another.*

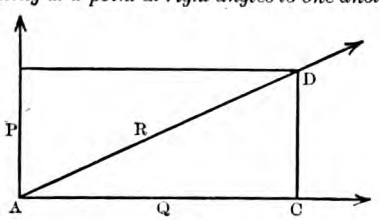


Fig. 38.

Let A B, A C represent the two forces P and Q acting at right angles to each other through the point A.

Complete the rectangle A B D C. Then A D represents the resultant force R.

Now $AD^2 = AC^2 + CD^2 = AC^2 + AB^2 = Q^2 + P^2$

$\therefore AD = R = \sqrt{P^2 + Q^2}$

65. *To find the magnitude of the resultant of two forces acting at a point.*

Let O A, O B represent the two forces P and Q acting at O. Complete the parallelogram O A C B.

Then O C represents the resultant R.

Draw C D perpendicular to O A or O A produced.

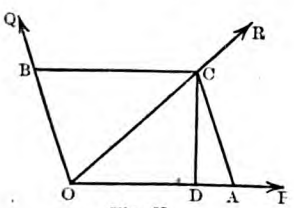


Fig. 39.

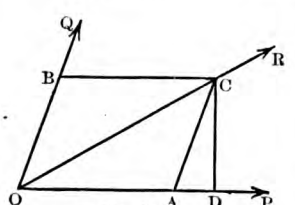


Fig. 40.

Then by geometry we know that

$OC^2 = OA^2 + AC^2 \mp 2OA \cdot AD$

$= OA^2 + OB^2 \mp 2OA \cdot AD$

$\therefore R^2 = P^2 + Q^2 \mp 2P \times AD$

The − sign must be taken when, as in Fig. 39, angle C A O is acute, and the + sign must be taken when, as in Fig. 40, angle C A O is obtuse.

SPECIAL CASES.

If O A and O B are at right angles to one another, then A D vanishes, i.e. A D = O and hence $R^2 = P^2 + Q^2$ as we saw before.

If O A and O B are inclined at an angle of 60° to one another then $AD = \frac{1}{2} AC = \frac{1}{2} Q$, and hence $R^2 = P^2 + Q^2 + PQ$.

The following is a list of the value of R^2 when P and Q are inclined to each other at certain angles.

For	0°	$R^2 = P^2 + Q^2 + \sqrt{4}\,PQ$
For	30°	$R^2 = P^2 + Q^2 + \sqrt{3}\,PQ$
For	45°	$R^2 = P^2 + Q^2 + \sqrt{2}\,PQ$
For	60°	$R^2 = P^2 + Q^2 + PQ$
For	90°	$R^2 = P^2 + Q^2$
For	120°	$R^2 = P^2 + Q^2 - PQ$
For	135°	$R^2 = P^2 + Q^2 - \sqrt{2}\,PQ$
For	150°	$R^2 = P^2 + Q^2 - \sqrt{3}\,PQ$
For	180°	$R^2 = P^2 + Q^2 - \sqrt{4}\,PQ$

66. *If two forces be represented by* A B, A C, *the sides of a triangle, their resultant will be represented by* 2 A D, *where* D *is the middle point of* B C. *For the diagonals of the completed parallelogram* A B E C *bisect one another, and hence* 2 A D = A E, and D *is the middle point of* B C.

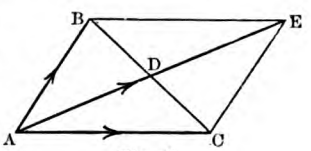


Fig. 41.

The straight line joining any angular point of a triangle to the middle point of the opposite side is called a **median.**

67. *The greater the angle between two forces the smaller will be the magnitude of their resultant.*

This follows at once from § 65.

The resultant is always nearer the greater force.

Let O A, O B represent two forces P and Q, of which P is the greater. Then by completing the parallelogram O A C B we get the resultant O C which represents R.

Now O C is said to be nearer O A than O B if angle A O C is less than angle B O C.

Now angle B O C = angle O C A, and A C = O B.

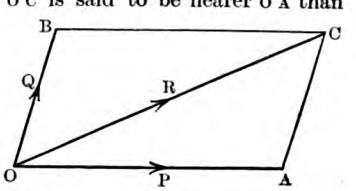


Fig. 42.

In triangle O A C, O A is greater than A C since P is greater than Q, therefore the angle O C A opposite the side O A, is greater than the angle A O C, opposite the

side A C. Therefore angle B O C is greater than angle A O C, i.e. O C is nearer to O A than it is to O B.

Example:—

Suppose a thread fixed at A passes round a smooth movable pulley B and over a fixed pulley C. Let

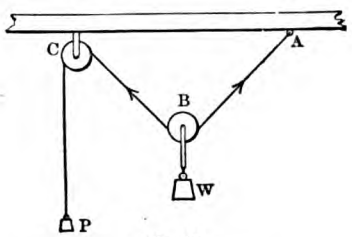


Fig. 43.

a weight W be attached to B and a weight P to the end of the thread hanging freely over C. Suppose the angle A B C formed by the thread be 45°.

Then W is the equilibriant of the forces acting along B A and B C, and these forces must be equal to each other and to the pull on the thread of the weight P.

Therefore W must equal in magnitude the resultant of P and P acting along B A and B C inclined at an angle of 45°, i.e. $W^2 = P^2 + P^2 + \sqrt{2}\,P \times P = P^2(2 + \sqrt{2})$.

68. The Triangle of Forces

If O A, O B be two forces acting at O, then O C, the diagonal of the completed parallelogram O A C B, represents their resultant. Therefore O C reversed, i.e. the force represented by C O, will be their equilibriant.

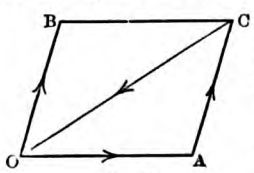


Fig. 44.

Now A C = O B and is parallel to O B, hence A C represents O B in magnitude and direction, though not in position. Therefore the three forces represented by O A, A C and C O, the sides of the triangle A C O, *will be in equilibrium if all three forces act at one point.* Conversely, if three forces acting at one point be in equilibrium, they may be represented by the sides of a triangle *taken in order.*

The triangle may be drawn anywhere, and its sides need not be drawn in the actual directions in which the forces act, but its sides must be proportional in length to the magnitudes of the three forces, and must be inclined to each other at the same angles as the directions of the forces. In other words, if the triangle be taken up, it must be possible to place it so that the sides are respectively parallel to the directions of the forces to the magnitudes of which the lengths are proportional.

Thus,

If three forces acting at the same point can be represented in magnitude and direction (but not in position) by the sides of a triangle taken in order, they are in equilibrium; and conversely if three forces acting at the same point are in equilibrium they can be represented in magnitude and direction by the sides of a triangle, these sides being proportional in length to the magnitude of the forces they represent, and parallel to the directions in which they act.

69. The Polygon of Forces

If any number of forces P_1, P_2, P_3, P_4, P_5, ... acting at a point O be represented by A B, B C, C D, D E, E A, the sides of a closed polygon, taken in order, the forces are in equilibrium.

Join A C, A D. Then A C represents the resultant of A B and B C; A D represents the resultant of A B and C D, i.e. of A B, B C and C D; and A E represents the resultant of A D and D E, i.e. of A B, B C, C D and D E.

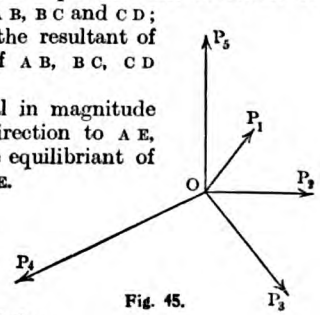


Fig. 45.

Now E A is equal in magnitude and opposite in direction to A E, therefore E A is the equilibriant of A B, B C, C D and D E.

Hence P_1, P_2, P_3, P_4, P_5 . . . . . represented by the sides of a closed polygon taken in order, are in equilibrium.

The converse may be similarly proved.

Thus,

If any number of forces acting at the same point can be represented in magnitude and direction by the sides of a closed polygon taken in order, those forces are in equilibrium and conversely.

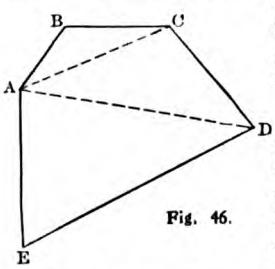


Fig. 46.

If the lines representing the forces do not form a closed polygon, then if X be the extremity of the last side of the polygon, the straight line drawn *from* A, the extremity of the first side, to X, will represent the resultant force. This is clear from what has just been proved.

We may express these results mathematically thus:

If the forces P_1, P_2, P_3, P_4 . . . . . acting at the same point are in equilibrium they may be represented by the sides, taken in order, of a closed polygon A B C D E . . . . .

and we have

A B : B C : C D : D E . . . = $P_1 : P_2 : P_3 : P_4$ . . .

In the particular case of the triangle of forces, we have A B : B C : C A = $P_1 : P_2 : P_3$.

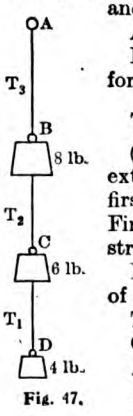


Fig. 47.

70. Examples:—

(1) A string supports a mass of 4 lb. at its extremity, another mass of 6 lb. above the first and a third of 8 lb. above the second. Find the tensions in the three parts of the string.

Let the string be fixed at A and the masses of 8, 6 and 4 lb. at B, C, D respectively.

The whole system is in equilibrium.

Consider the point D.

A downward force of 4 lb. weight acts at D.

∴ its equilibriant T_1 = 4 lb. wt.

Again consider C.

A downward force of 6 lb. wt. and 4 lb. wt. = 10 lb. wt. acts at C.

∴ its equilibriant T_2 = 10 lb. wt.

Finally a downward force of 8 lb. wt. + 6 lb. wt. + 4 lb. wt. acts at B.

∴ its equilibriant T_3 = (8 + 6 + 4) lb. wt. = 18 lb. wt.

(2) To find where a particle P must be placed in a triangle ABC, so that it may be in equilibrium under the action of forces represented by the straight lines PA, PB, PC.

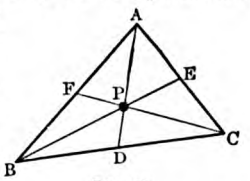


Fig. 48.

If D be the middle pt. of BC, then by § 66 (Page 227)

The resultant of the forces PB, PC = 2 PD.

Now if P is in equilibrium 2 PD must be equal and opposite to PA ∴ P must lie on the median drawn from A to the middle point of BC.

Now since 2 PD = PA ∴ AD = 3 PD, i.e. PD = ⅓ AD.

Similarly PE = ⅓ BE + PF = ⅓ CF

But the point P where the medians AD, BE, CF of a triangle ABC intersect, is such that PD = ⅓ AD PE = ⅓ BE and PF = ⅓ CF.

Hence the particle P must be placed at the point of intersection of the medians of the triangle.

(3) A body weighing 48 lb. is supported by two strings which are respectively 3 feet and 4 feet long and are fastened to points in the same horizontal line at such a distance apart that the strings make an angle of 90° with each other. Find the tension in each string.

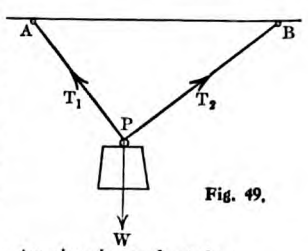


Fig. 49.

The three forces acting at P are

W = 48 lb. wt. T_1 and T_2.

Since AB is horizontal, W acts perpendicular to AB.

Also T_2 acts perpendicular to PA

and T_1 acts perpendicular to PB

∴ triangle ABP represents in magnitude the three forces in equilibrium, namely W, T_1 and T_2.

∴ AB : BP : PA = W : T_1 : T_2

Now PA = 3 ft. and PB = 4 ft. ∴ A = 5 ft.

Hence 5 : 4 : 3 = 48 : T_1 : T_2

∴ T_1 = ⅘ of 48 lb. wt. = 38·4 lb. wt.

and T_2 = ⅗ of 48 lb. wt. = 28·8 lb. wt.

Exercise 12

(1) Find the resultant of two forces acting at an angle of 45°, one of them being double of the other.

(2) Forces of 8 lb. and 10 lb. wt. act at an angle of 60°; find their resultant.

(3) Find the resultant of forces of $5\sqrt{2}$ and 2 grams acting at an angle of 135°.

(4) Two forces of 8 lb. and 12 lb. wt. act at angles of 60°, 90°, and 120° successively. Find the resultant in each case.

(5) Forces of 10 lb. and 12 lb. wt. act at an angle of 60°; find their resultant.

(6) Find the resultant of forces of 6 lb. and 8 lb. respectively acting at an angle of 45°.

(7) Forces of 16 lb. and 20 lb. wt. act at an angle of 60°; find their resultant.

Key to Exercise 11

(1) 26 lb. wt. (2) 10 $\sqrt{3}$ lb. (3) 200 $\sqrt{26}$ lb. (4) 13 grams wt. (5)

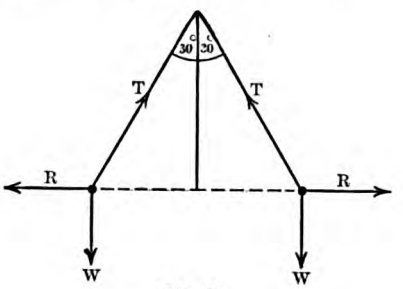


Fig. 50.

(NOTE.—This is not drawn to scale.)

W = ·2 gm., R = $\frac{\cdot 2}{\sqrt{3}}$ gm. = ·12 gm. approximately.

T = 2R = ·24 gm. approximately.

(6) Easterly velocity = 30 $\frac{\text{miles}}{\text{hr.}}$; easterly momentum = 19712000 F.P.S. units; easterly force = 27½ tons wt. The actual force deflecting the train acts at right angles to its path at each instant.

(7) 100$\sqrt{3}$ lb.

M. A. L.

LOGARITHMS.—III

IN the tables on p. 230 will be found the mantissae of the logarithms of all numbers from 1 to 1,000 worked to 4 places of decimals. The characteristic in each case is found by the rules given in the last lesson.

In the **first vertical column** are placed the first two digits, or figures, of any given number whose logarithm is required.

In the next **ten columns** are placed the third digits of any such number; these columns are headed **Third Figure.**

In the next **nine columns** are placed the fourth digits of any such number, and these columns are headed **Fourth Figure.**

If the number whose logarithm is required consists of one figure only, i.e. is one of the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, we must look in the first column for that figure followed by zero, then we shall find the mantissa of its logarithm in the same horizontal line under the first third-figure column (i.e. the third-figure column headed 0).

The characteristic for such a number consisting of one figure will, as we know, be 0.

Example:

Find the logarithm of 3. First we find 30 in the first column. In the same horizontal line in the third-figure column headed 0 we find the

mantissa ·4771. We know that the characteristic of log 3 is 0, hence we have log 3 = 0·4771.

To find log 30 we proceed in the same way, but we know that the characteristic of log 30 is 1, hence we have log 30 = 1·4771.

Similarly log 300 = 2·4771, and log 3000 = 3·4771. Again, log ·3 = $\bar{1}$·4771; log ·03 = $\bar{2}$·4771, and so on.

If the number whose logarithm is required consists of two figures, i.e. is one of the numbers 10 to 99, we again look in the first column for these two figures. Having found the number we again look in the same horizontal line in the third-figure column headed 0, and this gives us the mantissa of the logarithm. The characteristic for a number containing two figures in the integral part is, as we know, 1.

Example:

Find log 95. We find 95 in the first column, and then in the third-figure column headed 0 we find the mantissa ·9777. Hence log 95 = 1·9777.

Similarly log 950 = 2·9777; log 9500 = 3·9777.

Again, log 9·5 = ·9777, and log ·95 = $\bar{1}$·9777. while log ·095 = $\bar{2}$·9777, and so on.

If the number whose logarithm we wish to find consists of 3 figures, i.e. is one of the numbers 100 to 999, we look in the first column for the first two figures; having found these, we look in the same horizontal line in the third-figure column headed by *the same number as the third figure of the number whose logarithm we require.* There we find the mantissa of the logarithm.

Exercise 2

Find the logarithms of the following numbers:—
(1) 10, 7, 71, 98, 4.
(2) ·1, ·7, ·071, 9·8, ·004.
(3) 263, 49·5, ·00121, 576,000, 3·09.

The tables are worked thus for 3 figures. Now, supposing we want to find the logarithm of a number consisting of 4 figures. Let us find log 4296.

From the tables log 429 = 2·6325, and the log of the next high number, i.e. log 430 = 2·6335, log 430 − log 429 = ·0010.

Thus ·0010 is the increase in the logarithm, corresponding to the increase of 1 unit in the third place of the number. Now 1 unit in the fourth place of the number = $\frac{1}{10}$ of a unit in the third place of the logarithm. Hence for each unit in the fourth place of the number we add $\frac{1}{10}$ of ·0010 to the logarithm.

In our example there are 6 units in the fourth place; hence to the mantissa of log 429 we add $\frac{6}{10}$ of ·0010 = ·0006.

∴ log 4296 = 3·6325 + ·0006 = 3·6331.

TABLE OF LOGARITHMS

	THIRD FIGURE										FOURTH FIGURE								
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	4	8	12	17	21	25	29	33	37
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	12
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	3	3	4	5	6	7	8
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7

	THIRD FIGURE										FOURTH FIGURE								
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	1	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	3	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	2	2	3	3	4	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4

This is called the method of proportional parts, and the amount to be added in each case for a fourth figure has been worked out and placed in the fourth-figure column under the headings 1 to 9. Thus we can see what is to be added by inspection.

Exercise 3

Find the logarithms of the following:—
(1) 1568, 20·73, 9999, 5·207.
(2) 1001, 2350, 7·003, 1·305, ·006432.

placed in accordance with the characteristic of the logarithm.

Example:

Find the number of which 1·0573 is the logarithm.

First we are only concerned with the mantissa ·0573. In the first column we find ·05, and in the same horizontal line in the third-figure column headed 7 we find the antilogarithm 1140.

In the same horizontal line in the fourth-figure

TABLE OF ANTILOGARITHMS

	THIRD FIGURE										FOURTH FIGURE								
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
·00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1	2	2	2	2
·01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	2	2	2	2
·02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1	2	2	2	2
·03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	0	0	1	1	1	2	2	2	2
·04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	2	2	2	2	2
·05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	0	1	1	1	2	2	2	2	2
·06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	2	2	2	2	2
·07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	0	1	1	1	2	2	2	2	2
·08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	2	2	2	2	3
·09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	2	2	2	2	3
·10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	2	2	2	3	
·11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	2	2	2	2	3	
·12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	2	2	2	3	3	
·13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	2	2	2	3	3	
·14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	2	2	2	3	3	
·15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	2	2	2	3	3	
·16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	2	2	2	3	3	
·17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	2	2	2	3	3	
·18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	2	2	2	3	3	
·19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	2	2	2	3	3	
·20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	2	2	3	3	3	
·21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	2	2	2	3	3	3	
·22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	2	2	2	3	3	3	
·23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	2	2	2	3	3	4	
·24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	2	2	2	3	3	4	
·25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	2	2	2	3	3	4	
·26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	2	2	3	3	3	4	
·27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	2	2	3	3	3	4	
·28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	2	2	3	3	4	4	
·29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	2	2	3	3	4	4	
·30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	2	2	3	3	4	4
·31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	2	2	3	3	4	4
·32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	2	2	3	3	4	4
·33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	2	2	3	3	4	4
·34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	2	2	3	3	4	4	5
·35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3	3	4	4	5
·36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3	3	4	4	5
·37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	3	3	3	4	4	5
·38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	1	1	2	2	3	3	4	4	5
·39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3	3	4	5	5
·40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3	4	4	5	5
·41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3	4	4	5	5
·42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3	4	4	5	6
·43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	3	3	4	4	5	6
·44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3	4	4	5	6
·45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	3	4	5	5	6
·46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	3	4	5	5	6
·47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	3	4	5	5	6
·48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	4	4	5	6	6
·49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	4	4	5	6	6
·50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4	4	5	6	7
·51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	2	2	3	4	5	5	6	7
·52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	2	2	3	4	5	5	6	7
·53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	2	2	3	4	5	6	6	7
·54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	2	2	3	4	5	6	6	7
·55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	2	2	3	4	5	6	7	7
·56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	2	3	3	4	5	6	7	8
·57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	2	3	3	4	5	6	7	8
·58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	2	3	4	4	5	6	7	8
·59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	1	2	3	4	5	5	6	7	8
·60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	2	3	4	5	6	6	7	8
·61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	2	3	4	5	6	7	8	9
·62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	1	2	3	4	5	6	7	8	9
·63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	2	3	4	5	6	7	8	9
·64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	1	2	3	4	5	6	7	8	9
·65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	2	3	4	5	6	7	8	9
·66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	2	3	4	5	6	7	9	10
·67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	1	2	3	4	5	7	8	9	10
·68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	1	2	3	4	6	7	8	9	10
·69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	2	3	5	6	7	8	9	10
·70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	4	5	6	7	8	9	11
·71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6	7	8	10	11
·72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6	7	9	10	11
·73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	1	3	4	5	6	8	9	10	11
·74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	1	3	4	5	6	8	9	10	12
·75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	1	3	4	5	7	8	9	10	12
·76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	3	4	5	7	8	9	11	12
·77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	3	4	5	7	8	10	11	12
·78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	3	4	6	7	8	10	11	13
·79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	3	4	6	7	9	10	11	13
·80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	3	4	6	7	9	10	12	13
·81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	2	3	5	6	8	9	11	12	14
·82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	2	3	5	6	8	9	11	13	14
·83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	2	3	5	6	8	9	11	13	14
·84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	3	5	6	8	10	11	13	15
·85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	3	5	7	8	10	12	13	15
·86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	3	5	7	8	10	12	13	15
·87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	3	5	7	9	10	12	14	16
·88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	4	5	7	9	11	12	14	16
·89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	4	5	7	9	11	13	14	16
·90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9	11	13	15	17
·91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9	11	14	15	17
·92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10	12	14	15	17
·93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10	12	14	16	18
·94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10	12	14	16	18
·95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10	12	15	17	19
·96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	4	6	8	11	13	15	17	19
·97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	7	9	11	13	15	17	20
·98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11	13	16	18	20
·99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	5	7	9	11	13	16	18	20

By the accompanying table of **antilogarithms** we can find the number which corresponds to any given logarithm. The table is constructed similarly to the Table of Logarithms, and contains all mantissae between ·0000 and ·9999.

We find the first two figures of the mantissa in the first column, then in the same horizontal line in the third-figure column headed by the third figure of the mantissa we find the antilogarithm or number corresponding to the first three figures of the mantissa. In the same horizontal line in the fourth-figure column headed by the fourth figure of the mantissa, we find a number to be added to the antilogarithm already found. This gives us the number corresponding to the given logarithm. The decimal point must of course be

column headed 3 we find 1, this we add to 1140, which gives us 1141 as the complete antilogarithm. Now the characteristic of the given logarithm is 1, therefore the number must have two digits in its integral part. Hence 1·0573 = log 11·41.

Similarly 3·0573 = log 1141, and $\bar{2}$·0573 = log 01141.

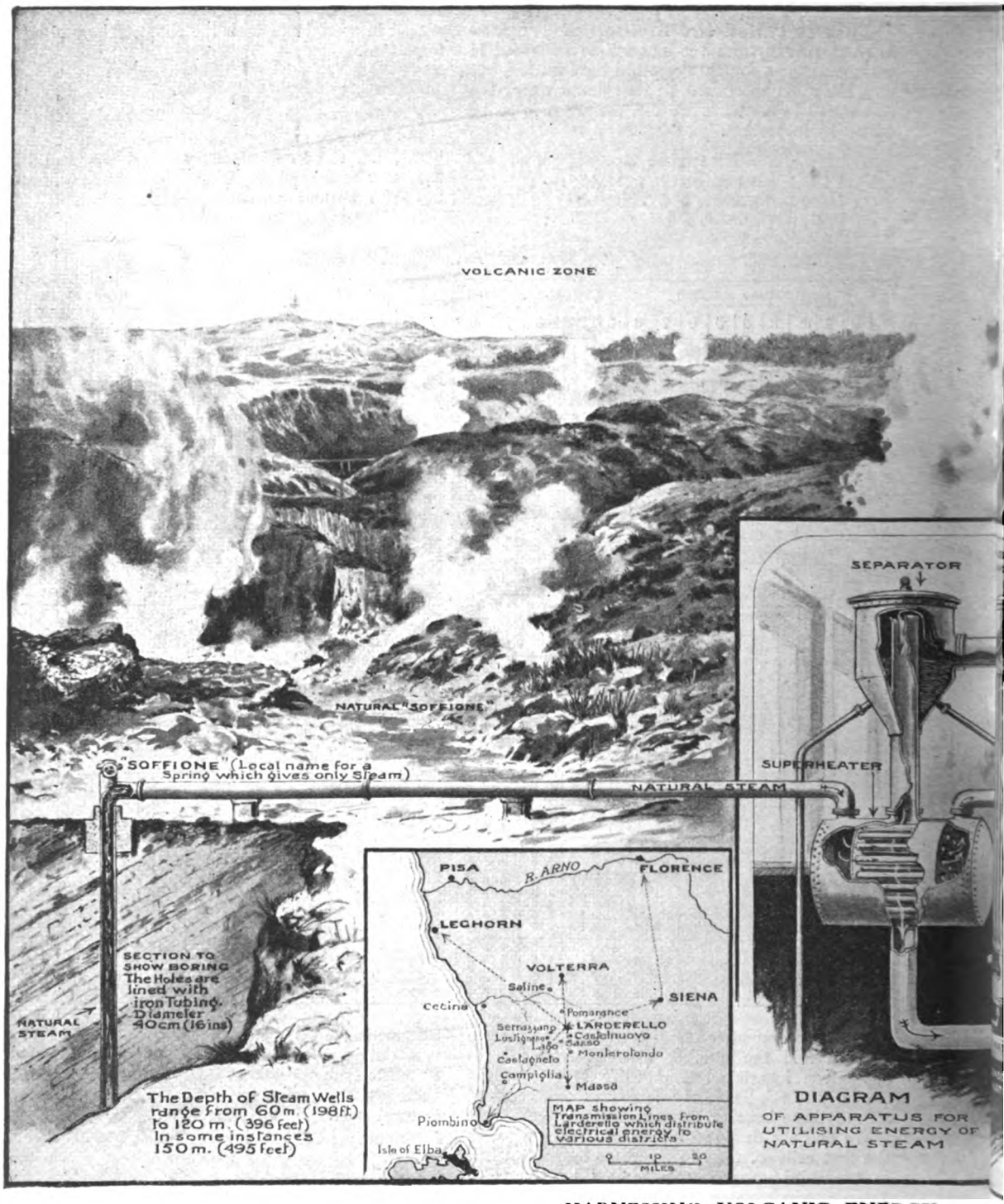
Exercise 4

Find the antilogarithms of—
(1) 0·7854, 2·0006, $\bar{1}$·999.
(2) 4·6050, 3·1635, $\bar{1}$·0707.

Key to Exercise 1

(1) 1, 3, 2, 5, −1, −3. (2) 6, 2, 3, 0, −5.

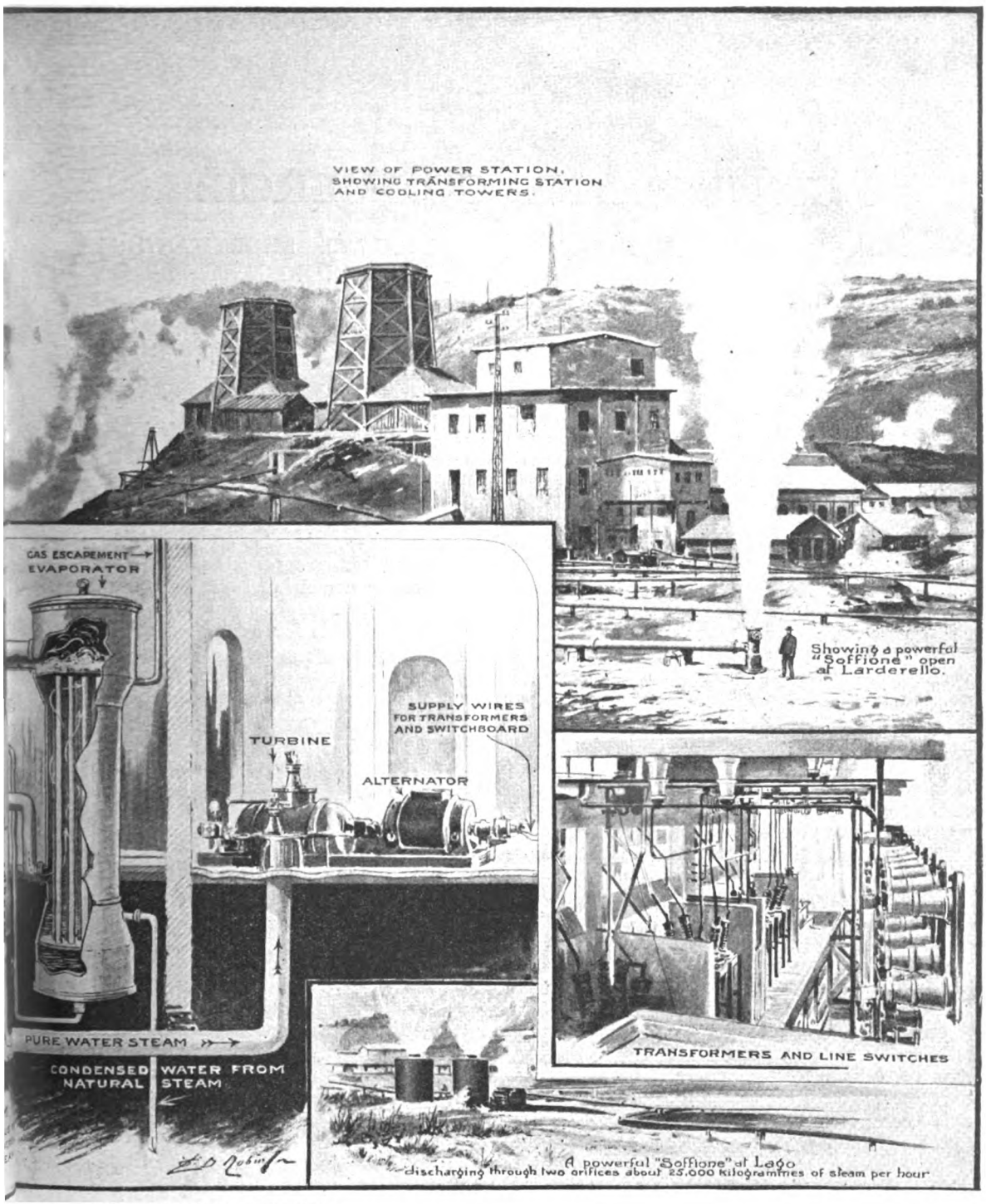
M. A. L.



HARNESSING VOLCANIC ENERGY

Volcanic forces hitherto have been regarded merely as a danger to man, but the remarkable Italian enter- Italy, where a new fuel supply would be an incalculable boon. The idea of using natural steam springs for the Larderello Works, decided to experiment. Encouraged by the good results, the Company erected a large Great War. The first unit was started in 1916, and the power station was completed in the same year.

(3) to Piombino ;



TO THE SERVICE OF MAN.

prise here illustrated suggests that they may be turned to beneficent uses—particularly in a country such as obtaining motive power has often been considered; and in 1905 Prince Ginori Conti, General Director of power station, with three units of 2,500 kw. each. The works were begun in 1914, but were delayed by the Four overhead lines at 36,000 volts now diverge from the transforming station: (1) to Siena; (2) to Leghorn: and (4) to Massa.

Continued from page 184.

BUSINESS AND COMMERCE:

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

COMMERCIAL TRAINING.—XXXII

ADVERTISING from the point of view of the wholesaler is totally different from that undertaken by the retailer. In the first place, it bids for a far wider appeal and aims at finding business in a vastly altered way.

In the majority of cases, wholesale firms possess complete advertising staffs of their own, under the direction of an advertisement manager.

Advertising Channels

Where, however, an unusually large advertising campaign is to be instituted, or some new commodity floated upon the market, it is customary, even when an advertisement department exists, for the firm to place the matter in the hands of advertising agents. A meeting of the various heads of departments would be called and a sum of money agreed upon for the cost of the campaign. Details of the commodity and of the sum to be spent would then be sent to a firm of agents, who would be asked to formulate a plan for the spending of the money to the best advantage. In certain circumstances two or more firms might be invited to tender a proposal in competition with one another.

And there are innumerable outlets for advertising matter, some costly and permanent, others less expensive but of short duration. To go through the list of available channels of advertising we have :—

1. The newspaper press. This may be again subdivided, so that we have : *a*. the London daily newspapers, both morning and evening ; *b*. The London weekly newspapers ; *c*. The London Sunday newspapers ; *d*. The local and provincial daily, weekly and Sunday newspapers ; and, *e*. The weekly periodical press and monthly magazines.

Each of these separate publications has its own tariff scale for advertisements. A whole front page in a London daily newspaper might cost £650 ; whilst a small space may be booked in a provincial weekly for a modest shilling.

2. After the newspaper, periodical and magazine press there are the hoardings that are to be found in every part of the country. The bills or posters that are to be displayed upon these hoardings are prepared to the order of the advertiser, and are then transferred to the bill-posters. Hoardings are generally the ownership of local bill-posting companies, but there are firms in London who will accept bills for exhibition in the country. The charge made for bill-posting is dependent upon the position, upon the space occupied, and also upon the length of time the bills are to remain exposed.

3. Circularising through the post is naturally an expensive form of publicity, but with a novel appeal is often most profitable. There are special agents in the metropolis who supply ready-addressed envelopes and wrappers for this type of publicity.

4. Circularising from house to house is usually left to local advertising agents who possess a staff of canvassers.

Permanent Publicity

Other and more permanent means of advertising are concerned with enamelled iron plates at the railway centres and in other conspicuous positions, signs beside the railways, painted signs on the sides of houses, omnibus and tramways advertising, and so on. The firms of advertising agents are closely in touch with all these ways and means ; and quotations for cost are obtainable at short notice.

The business man who would go extensively into advertising will find, however, that there is much to be learned. It is not sufficient merely to spend a given sum of money ; and there must be a careful selection in the actual outlet for that money. Then again, it is rarely profitable to advertise just

once. It is of the utmost importance that an advertisement shall be succeeded by a "follow-up"; and, generally speaking, it will be found that the best results come after the second display, as though the first merely whetted the appetites of the public whilst the second held and clinched their interest.

And, so far as the wholesale house is concerned, it is essential and imperative that the retailers shall be taken into its confidence in the matter of advertising, that co-operation may result. The retail man must be informed of the publicity well in advance, so that he may order in sufficient supplies to meet the expected demand; and if a retailer should be desirous of carrying through some purely local advertising, it will probably be to the advantage of the wholesaler to assist him financially over the matter.

To approach the actual routine of arranging for publicity, we may deal first with the newspaper press. Here the initial step is to decide upon the precise amount of money to be spent, and then to book the space required for the dates selected. In the meantime, it will be necessary to prepare the copy, as the matter itself is called, and also any pictures, diagrams or other devices.

The "Key" System

When the copy writer wishes matter to be boldly set out and displayed he writes the word "Display" in the margin; or "Compress" for the reverse. Italics or capitals he also orders in the margin; and a copy writer should possess a knowledge of types so that he may actually order the founts he desires. In fact, many newspaper printers issue fount books which contain samples and names or numbers for every variety of type they have available.

The copy is sent in, however, and in due time there comes a proof, which must be carefully corrected and signed. If an unreasonable number of corrections are made in this proof a special charge will be made. If there is time, and the corrections are too heavy to be quickly executed, many newspaper printers will be willing to submit a revised proof.

The actual preparation of advertising copy is the subject for a future lesson, but it may be well here to mention the importance of the "key" system in advertising, where a check has to be kept on the results. The key may consist of numbers or of initials of the particular newspapers taking the advertisement, or merely a series of letters.

Thus, a firm quartered at Albany Buildings and advertising in seven distinct newspapers would key their advertisements so that the replies from the first newspaper were addressed to No. 1 Albany Buildings; the second newspaper would be No. 2; the third, No. 3, and so on; and, as the replies to the advertisement came to hand, a clerk would take note of the numbers employed on the addresses and so would be able to prove conclusively from which particular newspaper the greatest number of replies had been received.

Then we may imagine Messrs. Brown and Sons inserting an advertisement in a range of papers. They would key their advertisements so that replies from the first newspaper were addressed to A. Brown and Sons; from the second B. Brown and Sons; from the third C. Brown and Sons, and so on. Or an advertisement in the *Saturday Journal* might be keyed Dept. S. J.; from the *Penny Magazine*, Dept. P. M.; from *Popular Gardening*, Dept. P. G., and so on.

Posters, Illuminated Signs, etc.

When preparing copy for the hoardings very much the same process has to be gone through, except that the method of reproduction varies. Usually, hoarding posters are produced from stone by the system of lithography. Thus, the copy writer prepares his text, and, together with the pictorial originals, sends them to the lithographer, who places them on the stone and in due time submits a proof. Or, as an alternative, the pictures may be reproduced by lithography and the text printed from letterpress.

Whichever course is taken must be dependent upon the price to be paid, the number of copies required and the precise nature of the particular job. In either event, the hoarding sheets are produced; and in due course find their way to the bill-posters, the lithographic stones being in most cases destroyed, though where there was an expectation of a repeat order they would be stored.

Other advertising schemes and plans, such as those connected with lighting, illuminated signs, mechanical figures in the shop window, and all such matters, are usually arranged by advertising agents, the majority of whom may be easily traced through the various trade journals. As to the efficacy of such forms of publicity, it must naturally depend purely upon the precise circumstances of the case, but every business man, be he wholesaler or retailer, must be prepared for an occasional novel departure in advertising, and with many trades such novelties are most profitable.

A. B.

CHOOSING A CAREER.—XXXVI

The Railways of this country offer a splendid career—particularly perhaps to the self-educated man. Railway posts are as permanent as those of the Civil Service to the workers who behave themselves and work diligently, promotion is certain to those who persevere, and, with the majority of grades, there is a superannuation fund which ensures all the advantages of a pension for one's declining years.

In a broad sense, one may divide railway service into three main branches. There is the black-coated staff quartered chiefly at the head offices, the men who direct and others who keep the books and accounts of the company that employs them. There are the engineers and constructive staff, usually stationed at the main depot of the company where engines and rolling stock is built and repaired. And, thirdly, there is the uniformed staff, the men and women who may be widely termed the railway servants.

Each of these three main groups must naturally be subdivided again into sections, and we will deal first of all with the black-coated class. But, in order to make the subject perfectly clear, it will be necessary first to peep into the head offices of a railway company.

Primarily, every railway company is controlled by a board of directors, who meet periodically in the board room at the head offices. Directors are noblemen and gentlemen with large financial holdings in the stock of the company, and to them at their meetings are brought reports as to the returns of the line and similar matters, whilst all important developments in the management of the line have to be sanctioned by them, and they are naturally called upon for vital decisions on subjects of policy.

But, apart from the board, railways are managed by a system of permanent and highly paid officials, and it is interesting to note that a few of the best known general managers of British railway companies have actually risen from humble positions, such as those occupied by signal-cabin boys, boy clerks and so on.

The general manager is the head of the entire staff, and his salary may be anything from £1,000 to £6,000 a year, according to the size and status of his company. Other leading officials are the secretary, the chief accountant, the superintendent of the line, the goods manager, the chief cashier, the chief engineer and, in some cases, the chief locomotive engineer. The salaries paid to these officers will vary from £500 to £1,000 a year, according to the importance of the line.

Each of these officials will have his own independent staff. The members of the staffs will be responsible to their own chiefs of department, the chiefs to the general manager, and the general manager to the Board of Directors. This, in fact, may be summed up as the chain of responsibility in the conducting of the operations of a railway company.

Generally speaking, the heads of departments on British railways are recruited entirely from the ranks of the black-coated class. The same remark applies equally to general managers, despite the fact that a few of them have actually risen from the uniformed ranks.

Among the high officials there has always been a tendency to change from company to company, one railway appointing as its general manager the superintendent of the line of another company, and so on. Lower in the scale, however, there is not this system of interchanging, which is really only the outcome of keen competition among the companies to secure the services of the very best and most individualistic men available.

Thus, to answer the query: "How can I become a superintendent of the line?" for example, the only possible reply can be: "Enter the service of a railway company as a junior and work your way up." It is very seldom indeed, except for the very highest officials, that a man is taken into the employ of a railway company from any other walk in life, unless he be a time-expired soldier seeking a post as a policeman.

We will assume then that a boy wishes to take up work at the head office of a company and to make for himself a career in the railway world. He should have received a good secondary school education and should then set about obtaining some personal influence to secure him a post as a boy clerk. With most companies it is usually sufficient to have the nomination of one director, and this may often be obtained merely by writing to one of these gentlemen, whose names are to be found in the company's official time-table or in the *Railway Year Book* at the public library.

A letter asking for nomination should be written in most respectful terms, should give particulars of the applicant and of his education, and reasons why he wishes to take up railway work as a career. Sometimes a boy's last schoolmaster will write and obtain a nomination for him.

The letter nominating an applicant for a position as boy clerk is then sent to the secretary of the company at the head offices, where it is registered until a vacancy occurs, and it usually happens that some months must pass before this time arrives.

There will come a day, however, when the applicant will be sent for to present himself at the company's head offices, and there, in the hands of one of the chief clerks, he will be put through an examination.

This usually consists of a test in simple arithmetic, writing from dictation, geography and composition. A knowledge of shorthand and typewriting is, however, invariably useful. Following upon this comes an examination under a medical officer of the company, and the applicant is called upon to produce his birth certificate.

Having passed these tests successfully, the boy clerk is appointed as a probationer, in some cases for one month, in others for two or three months, and at the end of that period, if he is favourably reported upon by his immediate superior, he will become a permanent junior clerk.

This is the routine with most of the companies. Some of the companies, however, do not require the nomination of a director, but select their juniors by a system of competitive examination held periodically for all suitable applicants. In every case there is an educational test, and it is usually the custom for the applicant to be called upon to produce a certificate of character from his last schoolmaster or from a minister of religion.

With every company the boy applicant should in any case first of all communicate with the secretary, acquainting him with the desire to join the service, and in all probability printed instructions will be forwarded to him. From fifteen to eighteen marks the usual limits of age for junior clerks.

Copying letters, keeping stamps, carrying messages, attending to the telephone, filing papers and documents—this is the type of work that falls to the lot of the junior in whatever department he may be placed; but every opportunity is given to a lad to show his natural bent, so that in time he may be transferred to the department for which he is best adapted.

Thus a boy with an aptitude for figures and mathematics would make it his business to exert all the influence he could eventually to reach the accountant's office; one with an affection for draughtsmanship and mechanics would seek the engineer's office; another with an aptitude for organisation and executive work would try to enter the general manager's office, and so on.

When once a boy has got his feet upon the lowest rung of the ladder at a railway company's head office (or in a branch office in the provinces) it will depend very much upon the steps he takes for his own self-education as to how he progresses. In some of the departments a working acquaintanceship with plans, drawings and mechanical matters is important; in some cases telegraphy is useful; and clerks who graduate to the secretary's department must understand stocks, transfer work and such matters.

A. C. M.

BOOK-KEEPING.—XXX

WE have already seen something of the relationship which exists between partners, but it is well to revise and note that Partnership is the result of contract or agreement. The agreement should be in writing, and should set out all the terms of the contract, otherwise the Partnership Act, 1890, applies as follows:—

Partnership Act of 1890

1. All partners are entitled to share equally in the capital and profits of the business, and must contribute equally to all losses sustained by the firm.

2. The firm must indemnify every partner in respect of payments made, and personal liability incurred by him in the partnership business, or necessary to preserve the business and property of the firm.

3. A partner advancing money beyond the amount of capital to be subscribed by him, shall receive interest at 5 per cent. per annum from the date of the advance.

4. No interest is paid on capital until an account has been taken and profits declared.

5. Every partner may take part in managing the business.

6. No payment can be claimed by any partner for any partner for services rendered, as he is bound to act in the firm's interests.

7. Books of the firm are to be kept at the principal place of business, and must be open to every partner, who may examine them or appoint a qualified agent to do so.

8. A majority of partners decides difficulties in management, but the nature or scope of the business cannot be altered without the consent of all; and no change in the constitution of the firm may be made without unanimous consent.

9. Where no time is fixed, notice by one partner to his co-partners will dissolve the partnership. Such a partnership is said to be at will.

In order that the above rules shall not apply where partners desire otherwise, Articles of Partnership are drawn up.

Many matters of importance should be provided for in the partnership agreement, and well-drawn " articles " will, as a rule, include the following :—

(*a*) The STYLE of the firm or firm's name.

(*b*) The nature of the business, which includes the whole question of administration, the extent to which a partner's authority is to be limited or controlled, and the powers to be given to, and exercised by, a majority of the partners.

(*c*) The duration of the partnership, and the time of commencement of business.

(*d*) Questions of payment of premiums, and return of premium in case of premature dissolution.

(*e*) The capital and property of the firm, how it is provided, and the uses to which it is to be put. If assets other than cash are contributed by a partner, the value should be assessed, and that value credited to the partner as capital.

(*f*) Interest on capital and time of payment, interest not being payable in the absence of provision until profits are ascertained.

(*g*) Provision is often made for periodical drawings by partners against future profits with a further condition that interest is payable on such drawings.

Dissolving Partnership

Partnerships may be dissolved in various ways, the majority of which are noticed in the following lines :—

1. By notice in case of a partnership at will.
2. Efflux of time.
3. Completion of the object of the partnership ; e.g. for the working of a certain mine, the contract ending on the working out of minerals.
4. Death of a partner without other provision being made in the agreement or in absence of agreement.
5. Bankruptcy of a partner.
6. Illegality of object or of the contract itself ; e.g. if an alien and an Englishman are in partnership, and war breaks out between the alien's country and ours, the partnership is forthwith dissolved.
7. By the court in the following cases :—

(*a*) When a partner is a lunatic or of permanently unsound mind, dissolution at the request of any partner or of the lunatic partner's representatives will as a general rule be granted.

(*b*) When a partner is permanently incapable of performing his part of the contract.

(*c*) At the suit of another partner, when a partner is guilty of conduct prejudicially affecting the business.

(*d*) When a partner wilfully breaks the partnership agreement, and so conducts himself as to make it impracticable to carry on the business.

(*e*) When the business is carried on, and can be only carried on, at a loss.

(*f*) When it is just and equitable to dissolve the partnership.

On the dissolution of partnership every partner has a right, in the absence of any agreement to the contrary, to have the goodwill of the business sold for the common benefit of the partners.

Liquidation

The partnership exists, after dissolution, as long as may be necessary to wind up the concern.

If on dissolution there be no sale of the goodwill nor any provision as to the use of the firm's name, every partner may carry on business under that name, so long as in so doing he does not *hold out*, his former partners are still continuing and so exposing them to risk of liability.

Each partner is entitled on a dissolution to have :—

1. The firm's property realised and applied in payment of debts of the firm and other liabilities.
2. The surplus applied to pay what is due to the partners for :

(*a*) Interest and principal of loans.
(*b*) capital.
(*c*) profits.

If no agreement exists, losses are to be paid first out of profits, next out of capital, and if not then covered, by the partners in the same proportion as they share profits.

From what we have seen, the share of a partner in a firm is not something tangible; it is a right to receive in due course and in the events above mentioned a certain proportion of the existing partnership assets remaining at any given time if all were realised and all debts and liabilities had been duly discharged.

If any assets remain after the losses are covered, they are applied as follows :—

(1) In paying debts and liabilities of the firm to persons not members of the firm.

(2) In paying advances made by partners.

(3) In paying capital out to each partner rateably.

(4) Lastly, if any assets remain they are divisible amongst partners in the same proportion as the profits are.

On dissolution the books are closed by realisation of assets and the drawing up of a realisation account. Any gain or loss on realisation is carried to the Capital Accounts of the partners. The Cash received is utilised to pay off liabilities as shown in the Cash Account or Cash Book, the balance being carried to the credit of the partners' capital or any shortage being debited to partners, i.e. *Capital Account* is debited with surplus or credited with shortage.

Carefully follow the working of the following realisation. There is a loss on realisation which is shared equally by the partners.

A., B. and C. are in partnership. Their

REALISATION ACCOUNT

	£	s.	d.		£	s.	d.
To Sundry Assets	3,500	–	–	By Cash	3,000	–	–
,, Cash (Expenses)	50	–	–	By Balance (Loss)			
				A. ⅓ £183 6 8			
				B. ⅓ 183 6 8			
				C. ⅓ 183 6 8			
					550	–	–
	£3,550	–	–		£3,550	–	–

SUNDRY CREDITORS

	£	s.	d.		£	s.	d.
To Cash	1,000	–	–	By Balance	1,000	–	–

A.'s CAPITAL ACCOUNT

	£	s.	d.		£	s.	d.
To Loss on Realisation	183	6	8	By Balance	2,000	–	–
To Cash	1,816	13	4				
	£2,000	–	–		£2,000	–	–

B.'s CAPITAL ACCOUNT

	£	s.	d.		£	s.	d.
To Loss on Realisation	183	6	8	By Balance	1,500	–	–
To Cash	1,316	13	4				
	£1,500	–	–		£1,500	–	–

C.'s CAPITAL ACCOUNT

	£	s.	d.		£	s.	d.
To Loss on Realisation	183	6	8	By Balance	500	–	–
To Cash	316	13	4				
	£500	–	–		£500	–	–

CASH BOOK

	£	s.	d.		£	s.	d.
To Balance ..	1,500	–	–	By Realisation Accs.	50	–	–
Realisation Ac.				,, Sundry Creditors	1,000	–	–
Premises £1,700				,, Balance:			
Stock 900				A.	1,816	13	4
Debtor 400				B.	1,316	13	4
	3,000	–	–	C.	316	13	4
	£4,500	–	–		£4,500	–	–

Balance Sheet at October 31, 19 . ., was as follows :—

Liabilities	£	Assets	£
Creditors ..	1,000	Premises ..	2,000
A. Capital ..	2,000	Stock	1,000
B. „ ..	1,500	Debtors	500
C. „ ..	500	Cash	1,500
	£5,000		£5,000

They share profits equally. They decide to dissolve partnership forthwith. The costs of dissolution amount to £50. The Assets are sold and realise :—Premises, £1,700 ; Stock, £900 ; and Sundry Debtors, £400. Show the final Accounts.

(Central Association of Accountants.)

Definitions of Terms

Novation.—Novation takes place where a person buys a business of another, taking over the debts and liabilities with the consent of the creditors. Novation may be brought about by implied consent of conduct, as where a creditor of a partnership firm goes on dealing with the firm after a change in its constitution has come to his notice.

Holding Out.—If a man represents himself or allows himself to be represented as a partner, he is liable as a partner to anyone who, on the faith of such representation, gives credit to the firm. Such a party is said to " hold himself out " as a partner. The commonest example is found in the case of a partner retiring. If such partner gives no notice of his retirement, he allows the customers and existing creditors of the firm to presume that he is still a partner. Two conditions are necessary to make the person liable :—

(*a*) The holding out must be something done by, or with his consent.

(*b*) The holding out must have been known to the other party and acted on by him.

Retiring Partner's Liability.—On retiring, a partner is still liable to creditors for debts incurred whilst he is a member of the firm, even though his co-partners have released him. In order that his liability shall cease, the creditors of the firm must also give him his release, such being the case when the creditors impliedly or expressly accept a new partner in place of the old one as their debtor. (*See* Novation.)

Notice.—In case of old customers and creditors, notice in fact must be given, i.e. by circular or some such method, but in case of persons who have not hitherto dealt with the firm, an advertisement inserted in the " London Gazette," and advisedly in the local papers, is sufficient notice of severance of partnership.

Incoming Partner.—An incoming partner is not liable, without a contract to that effect, for debts incurred before he joined the firm, and he is not liable to creditors, even though he takes over a retiring partner's liability, unless the creditor is a party to such novation.

Exercise

A. and B. are in partnership, trading as A., B. and Co. On June 30, 19.., their Balance Sheet was as follows :—

	£	£		£	£
Capital Accounts :—			Cash in Hand	50	
A.	10,500		Cash at Bank	2,350	
B.	6,000				2,400
		16,500	Sundry Debtors		6,600
Sundry Creditors :—			Machinery and Plant		7,500
Open Accounts	4,000		Patent Rights		4,500
Bills Payable	500				
		4,500			
		£21,000			£21,000

A. and B. share profits and losses in the proportion of three-fifths and two-fifths respectively. As from July 1, 19.., A. and B. agree to admit C. as a partner, who is to bring in as his capital £6,000. A Goodwill Account is to be opened for £7,500, which sum is to be credited to A. and B. in proportion as they share profits. Each partner is to be credited with 5 per cent. interest per annum on capital, and to be charged with 5 per cent. interest per annum on drawings ; they draw £45 each on the last day of each month.

Profits in the new partnership are divisible as to A., one-half ; B., three-tenths ; and C., one-fifth. For the six months ended December 31, 1912, the profits (before dealing with interest) amounted to £2,700. Show the Partners' Capital Accounts and draw up Balance Sheet as at December 31, 19...

Key :—Balance Sheet at commencement of new partnership, £34,500 Total. Interest on each partner's drawings, £2 16s. 3d. Profit after dealing with interest, £1,958 8s. 9d. A.'s capital, £16,081 8s. 2d.; B.'s capital, £9,539 14s. 4d.; C.'s capital, £6,268 17s. 6d. B/S total at December 31, £36,390. F. H.

Continued from page 194.

HISTORY:

Contributors:—J. A. Brendon, B.A.(Oxon.), F.R.Hist.S.; F. Collinson, F.R.Hist.S.; T. P. Evans, B.A.(Oxon.); James A. Manson; L. Stampa, M.A.(Oxon.); and J. B. Sterndale-Bennett.

FRANCE UNDER LOUIS XIV.—I

In order to understand aright the nature and growth of the ascendancy which France enjoyed under the Grand Monarch it is necessary to review some of the salient events in the reign of his immediate predecessor and father, Louis XIII. For though Louis XIV. professed and practised perfect absolutism, he only reaped where Richelieu had planted and Mazarin watered.

Deplorable as was the misery in which the thirty years of the Religious Wars had plunged the unfortunate people—for the personal popularity of Henry IV., notwithstanding his pious aspiration, had brought very few fowls to the peasant's pot of a Sunday—France was fated to fare still worse during the first half of the rule of the gallant Henry's son, the 13th Louis.

Regency of Marie de' Medici

Unhappily Louis XIII. was only nine years old when his father was assassinated and his country, therefore, suffered in full measure the wretchedness which attends a minority. His mother, Marie de' Medici, assumed the regency and promptly undid the foreign policy of Henry IV., who was bent upon curbing the boundless ambition of the house of Habsburg, which aimed at establishing its supremacy in Europe. She entered into a firm alliance with Spain, and gave her son in marriage (1615) to Anne of Austria, Philip III.'s daughter. But the favour she showed to Concino Concini, an Italian adventurer, and his wife Leonora Galigai, offended the haughty nobles, and young Louis, at last asserting his authority, ordered the arrest of Concini, now Marquis d'Ancre. The conspirators bettered their instructions and slew the favourite in the Louvre (1617), his wife being executed shortly afterwards for sorcery.

Meanwhile fresh trouble was brewing with the Huguenots, who had viewed with profound suspicions the Queen-Mother's pro-Spanish policy, and who, it may well be supposed, had not forgotten the hideous massacres of Bartholomew (1572). These came to a head when the King, at the instigation of the Jesuits, forcibly restored Roman Catholicism in the province of Béarn in 1620.

Religious Strife

The Protestants throughout France rose, but their leaders, the Duke of Rohan and the Lord of Soubise, were poorly supported and ultimately capitulated at Montpellier on October 21, 1622. The ensuing Peace deprived the Huguenots of the right of political assembly which the Edict of Nantes had granted, and also reduced the number of guarantee towns to two—La Rochelle and Montauban—but confirmed, within the territorial limits prescribed by the deed of 1598, their freedom of conscience and public worship. The recrudescence of religious strife, however, had one wholly unlooked for effect which revolutionised the character of the reign.

While conducting the siege of Montauban (1621) the King's favourite, the Duke of Luynes, died of fever, and Marie de' Medici regained some of her original influence at Court. Under her patronage—for he had healed an earlier rupture with her son—Armand du Plessis de Richelieu (born at Paris in 1585), Bishop of Luçon, made an effectual entry into the political arena. His hopes in this direction had hitherto been countered by de Luynes, but his way was now clear. He had been created Cardinal in 1622, and in April, 1624, was admitted to the King's council, becoming a few months later Louis' chief Minister. Henceforward, in spite of the enmity of avowed foes and the distrust of friends, he never looked backwards. He lived for power, and, though he had to exercise it through his Royal master, took care to do all the guidance. And unstable and infirm of purpose as Louis was, it is to his credit

that he had the sense to recognise his Minister's genuis for governance and statesmanship.

Richelieu's policy was in the highest degree patriotic, in as far as it regarded the elevation of France to the first rank and the corresponding humiliation of Austria and Spain. He was equally capable in the direction of home and foreign affairs, and his iron will carried him over every obstacle, even conquering for a time the physical weakness which afflicted him throughout life.

No sooner had he acquired power than he gave a taste of his quality. A prince of the Roman Catholic Church, he did not hesitate heartily to support the Protestant princes of Germany in arms against the monstrous pretensions of the Emperor Ferdinand II., or to co-operate a few years later (1631) with Gustavus Adolphus, the Pillar of Protestantism, towards the same end.

Richelieu and the Huguenots

To prevent friendship between Spain and Great Britain—an alliance which he saw plainly would be fatal to France—he successfully broached (1624) a marriage between Prince Charles of England and Louis' sister, Henrietta Maria, the latter usurping the place of Philip IV.'s sister, Donna Maria.

But Richelieu knew that to be powerful abroad he must be free at home, and he proceeded to set his house in order. Taking umbrage at the numerous irritating breaches of treaty, the Huguenots revolted more than once, and at length Richelieu determined to put an end to their power of offensive. After a most heroic siege La Rochelle surrendered (1628), and the Protestants were at the Cardinal's mercy.

But it did not suit Richelieu's policy to drive them to despair, and he left them (by the treaty of Alais, 1629) religious liberty, on the footing of ordinary subjects.

As for the grasping nobles, he ruthlessly suppressed their exactions and required their fortresses, save on the frontiers, to be demolished.

These vigorous measures provoked retaliation, perhaps asked for it. Richelieu's hostility to Austria infuriated Marie de' Medici, who found in the angry and embittered nobles plenty of tools to her hand. She induced the King to dismiss his Minister who, at the moment, imagined his reign was over. Later in the same day (November 10, 1630), however, while Paris was agog for tidings of his fall, Richelieu forced himself upon Louis, and a spirited interview terminated in his restoration to favour. The Queen-Mother went into voluntary-compulsory exile, first to Compiègne, next to Brussels, and then to London, and the other conspirators sought safety in flight. No wonder onlookers called the day *La Journée des Dupes.*

The tragi-comedy consolidated Richelieu's power, making him, indeed, stronger than ever. His wise and resolute handling of foreign affairs ensured the King's respect and created some sense of *amour propre* even in the downtrodden and long-suffering masses, while enemies in the Royal household were unexpectedly checkmated by the birth in 1638 of an heir to the throne after twenty-three years of married life.

But Conspiracy had yet to shoot its last bolt. Louis deigned to listen to certain charges which his young favourite, the Marquis of Cinq-Mars, preferred against the Minister, but the latter was able to prove that, if there were treason in the air, it was the Marquis and not he that was the traitor. Richelieu exacted a terrible revenge, Cinq-Mars and his accomplice, de Thou, the historian's son, both being executed. The Cardinal survived his victims only a few months, dying in Paris on December 4, 1642.

Death of Louis XIII.

Next year (May 14), Louis followed his Minister to the tomb, but had already placed in control of affairs Cardinal Jules Mazarin (born at Rome in 1602), who had collaborated with Richelieu, knew his policy and probably his State secrets, and was ready to carry on the administration as far as he could on "one-man" lines. He was a statesman of different mould and calibre from his famous colleague, not so versatile, uninstructed in domestic questions, but an accomplished diplomatist, and, so to say, more human.

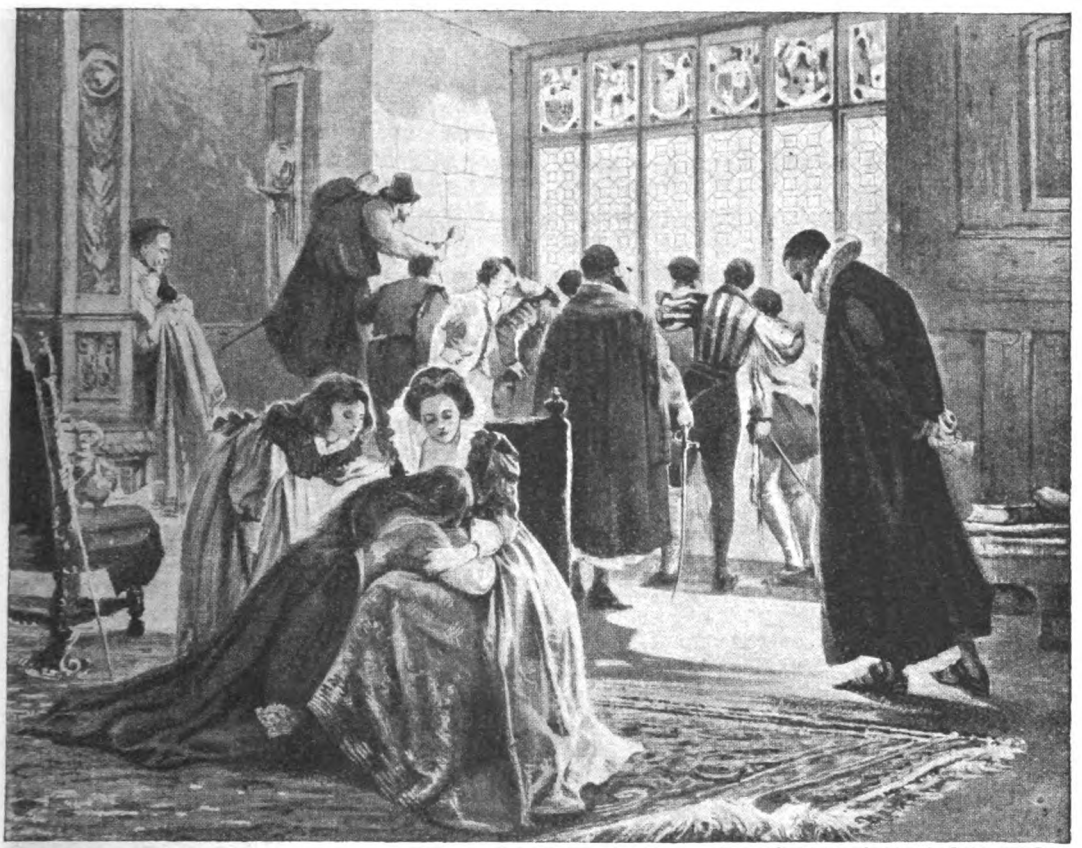
Louis XIV. was but a child at his father's death and France was again exposed to all the dangers of a minority rule. However, Anne of Austria, who had been invested with the regency with full powers, stultified expectant opinion, which was aware of her Spanish sympathies and of Mazarin's devotion to Richelieu's programme in this respect, by retaining the Minister in the chief office. He had won her confidence and affection, and is said to have privately married her at a later date.

Early in the new reign the congresses had been held which concluded the Peace of Westphalia (1648), the terms of which, so far as France was concerned, were a tribute to Richelieu's skill as a foreign Minister.

France acquired the major share of Alsace, excepting Strasbourg, and certain towns in the Rhine country—Metz, Toul and Verdun—already in her keeping, besides obtaining, as one of the guarantor States (Sweden being the other), a right of interference in the internal affairs of the Empire.

But such matters were of secondary importance at the time, for the condition of the finances—the unseen and seamy side of a spirited foreign policy—had grown desperate, and in his attempt to remedy it Mazarin encountered the fierce hostility which precipitated the civil war of the Fronde. The strife lasted from 1648 to 1652 and divided itself into two acts. In the first act the opposition proceeded from the Parliament and populace of Paris, and in the second from the nobles.

Under cover of espousing the people's protest against oppressive taxes, like that on food imported into Paris, the Parliament—really a law court and now stuffed with lawyers—fought for its own overblown privileges. One of its duties was to register Royal edicts before these became operative, and latterly it had maintained that this implied the right of refusal to register. The claim was audacious and absurd, since, if allowed, it would render legislation nugatory. Richelieu had disdainfully ignored it, but Mazarin was more amenable. Moreover, some of the financial proposals tapped the pockets of the whole official class, which retaliated by demanding that the suggested new taxes should be seriously modified and that the overseers to whom Richelieu had assigned the powers of levying assessments, recruiting, and the like should be abolished. Really the Parliament aimed at breaking up the



From the picture by P. H. Calderon, R.A.

IN THE HOUSE OF THE ENGLISH AMBASSADOR DURING THE MASSACRE OF ST. BARTHOLOMEW (AUGUST, 1572),

when the streets of Paris ran with the blood of some 30,000 slaughtered Huguenots. The massacre marked the climax of the great religious upheaval which disturbed France in common with most European countries during the sixteenth and seventeenth centuries, but from which France was just emerging when Louis XIV. ascended the throne.

centralisation which the same Minister had deliberately developed to a dangerous degree.

Mazarin's efforts at compromise being contumeliously rejected, he ordered the arrest of the President and two other members on August 26, 1648. Next day the mob replied by raising barricades in the streets (*la Journée des Barricades*). The whole episode, though dignified as "war," was disgraceful, and as the city Arabs used slings (*fronde*) in their bickers, the war was called the Fronde, largely by way of contempt. The Court wobbled at first, retiring at one stage to Rueil and at another to St. Germain-en-Laye, and in vain offering certain concessions.

Forthwith the contest degenerated into a despicable attempt to recover their privileges on the part of the insolent nobles, who were nicknamed the *petits maîtres* and who induced the great Condé to champion their cause. Now the Government began to act firmly, and Condé and other nobles were arrested. This spread the revolt into the provinces and Mazarin yielded, releasing the high-born prisoners and retiring to Brühl, near Cologne.

Suppression of the Fronde

Naturally Condé regarded this as a sign of weakness and hastened to Paris, where his ill-concealed pride and arrogance led him to commit so many outrageous blunders that Anne had the boy-King declared of age, a step which put Condé and his supporters hopelessly in the wrong as guilty of treason. Civil war on a wider scale ensued, Condé leading the rebels' forces and Turenne those of the Sovereign and Court. Mazarin was recalled, greatly to the anger of the Parisians, who clamoured for his banishment anew but who did not go over to the enemies of the State.

When Condé reached Paris his force must have been annihilated but for the dare-devil bravery of Mademoiselle de Montpensier, the daughter of Gaston of Orleans, who roused the people and bade them open the gate of St. Antoine. Mob rule supervened and paralysis overcame all State and civil business. Mazarin, feeling that his presence was a disturbing element, voluntarily retired; the more responsible sections of the community agitated and laboured for peace; Condé, obliged to withdraw, defected to the Spaniards; the King's authority was restored (October 15, 1652), and the Fronde passed into history. Four months later Mazarin was welcomed to Paris by Louis and the people and triumphantly resumed office.

Meanwhile the war with Spain dragged its slow length along. When Condé joined his country's enemies he was at once entrusted with the chief command. The duel between him and Turenne, had the cause been nobler, would have aroused altogether exceptional interest, but Condé was now self-placed in a false position and doubtless felt this acutely. Turenne, adopting the strategy of attrition, gradually got the better of his great adversary—incidentally giving the young king his "baptism of fire" at the siege of Stenay in 1654, but when (as a consequence of Mazarin's bargain with Oliver Cromwell) his ranks were stiffened with 6,000 of the renowned Ironsides, he quickened the pace and won the battle of the Dunes in 1658, which also secured the cession of Dunkirk to England.

"L'État! C'est moi!"

That Spain had had enough fighting, the Peace of the Pyrenees (1659) afforded eloquent testimony, for in the north France acquired Artois as well as several fortresses in Flanders, Hainault, and Luxemburg, and in the south Roussillon and Cerdagne. *Per contra*, a pardon was given to the haughty traitor Condé, who was restored to his private property and reinstated in his official posts and the Governorship of Burgundy. And Louis XIV. contracted to marry the Infanta, Maria Theresa, the marriage taking place in the next year. The nuptials were to cost France vastly more than she gained by the Pyrenean Peace: but of this pleasing outcome there was as yet no hint.

The treaty was Mazarin's last victory, but he retained the king's complete confidence until his death at Vincennes on March 9, 1661. Louis was then in his twenty-third year and it bespeaks an unsuspected fineness of feeling and tenderness of heart that he did not take up the reins of power until the death of the Minister by whose precept even more than his practice he had profited so much.

As his whole career proved, Louis XIV. was an apt pupil of Mazarin's. He had himself witnessed such a constitutional body as the Parliament of Paris wantonly abuse its powers, and the nobles subordinate national interests to their own petty and selfish ends. Little wonder he held cheaply a form of government in which everyone seemed to have an axe to grind and to act on the principle of "the Devil take the hindmost."

When he assured the incredulous courtiers

From the picture by Delaroche in the Wallace Collection.

CARDINAL RICHELIEU IN HIS STATE BARGE

accompanying on their way to execution two favourites of the King, Cinq Mars and de Thou, who had dared to breathe words against him. This was the Cardinal's revenge.

that *he* was the State (*"L'État! C'est moi!"*) he was not indulging in blague or persiflage. The utterance represented the sincerest conviction of his mind. Throughout young manhood he had seen Mazarin in sole command, and knew how the system worked. Moreover, Mazarin himself had urged Louis to be his own Prime Minister. So the young King's orders were immediate and imperative :—No decree was to be sealed except by his sanction and none of the State secretaries was to sign anything without his bidding. He struck the note of absolutism firmly from the very beginning.

Louis' next care was to install a plant or machinery which should be thoroughly efficient, and on which he could implicitly rely. Therefore he set up several councils of strictly limited size, of which the four chief dealt with (1) reserved questions of State, (2) home affairs, (3) finance, and (4) justice. At first he was exceptionally fortunate—just as latterly he was the reverse—in his choice of heads of these departments, or Secretaries of State, but the greatest of these was Jean Baptiste Colbert (1619-1689), one of the ablest men France has ever produced. He was trained by Mazarin in the art of administration, but his supreme gift for finance was all his own, and Louis was more fortunate than he knew to have this born genius at his service.

Colbert and Finance

So menacing was the state of the finances that unless it were drastically but scientifically handled at once, national bankruptcy was inevitable. The first thing Louis did was to condemn the superintendent Nicolas Fouquet to imprisonment for life for malversation of the public funds, the second was to abolish the office, and the third and last and best was to appoint Colbert to the control of the Exchequer. Colbert took a wide view of his duties, extending it to everything which entailed the expenditure of money, and pursued reform with the passion of a lover. He was relentless, and struck hard at fraud and corruption.

He repudiated State debts to which no clear title could be shown, reduced the rate of interest arbitrarily, redeemed bonds by discharging the advance less interest already paid, and so on. Such procedure involved much hardship, but Colbert required the individual to suffer for the sake of the common weal. He insisted upon diligence, honesty, and scrupulous care in the harvesting of taxes, and narrowly observed collector and receiver alike. He revised the modes of assessment, imposed fresh taxes where he thought it worth while, and tried always for simplicity in the working of the whole fiscal system. Had he had less intricate, less inflamed, and less confused mischiefs to cure—less of an Augean stable to cleanse—he would have abolished the farming of taxes and gathered them directly.

Home and Foreign Trade

Manufactures and commerce also demanded Colbert's closest attention. Industries were to be encouraged by a high protective tariff ; canals were to be dug to improve communication and facilitate inland trading ; the Crown was to patronise industry practically by becoming a producer, hence the revival (1667) of the famous tapestry factory of the Gobelins ; the *noblesse* was enjoined to take an interest, without prejudice, in shipping and merchandise, provided it did not keep shops ; guilds were to exercise strict supervision over the quality of the goods made and sold ; and facilities were to be offered to foreign manufacturers to settle and introduce such industries as were in some request, but not yet carried on in France. Companies were founded to trade with the East and West Indies, the Levant, Russia, and Africa, and colonies were promoted or started in Madagascar, North America — does not the name of Louisiana embalm the memory of the King ?—Canada, India, and elsewhere.

Shipping and shipbuilding, so long neglected, were fostered and a strong navy became a *sine qua non*. Richelieu recognised this last desideratum and initiated the needful steps, but Mazarin had allowed the project to lapse, and it was left to Colbert's energy and enterprise to furnish France with the strongest navy in the world. In the administration of justice an attempt was made, by means of civil, criminal and commercial ordinances, to remedy procedure and put a period to the vile abuses and scandals which were rampant, the Code Louis remaining in force until it was superseded by the Code Napoleon. But torture was still practised, bankrupts were treated as gross delinquents, and prisoners were denied the assistance of counsel in criminal causes.

Nor was this the measure of Colbert's reforming and innovating zeal, for he founded and promoted the Academy of Inscriptions and Medals (1663), the Academy of Sciences (1666), the French Academy at Rome (1666), the Academy of Music (1669), and the Academy of Architecture (1671). Agricul-

ture, the Cinderella of the industries, he still left severely alone, probably because to him it was literally *terra incognita*.

In some respects Colbert was too active, too interfering, too much addicted to organisation, for he destroyed initiative, and when his guiding spirit and superintending in war, blindly denounced Colbert as the author of all their woes.

For the King early disclosed that military glory was his ruling passion, and in François Michel Le Tellier, Marquis of Louvois (1641-1691), he had a War Secretary who encouraged him to the top of his bent. Indeed,

"L'ETAT! C'EST MOI!"

Louis XIV., soon after his accession (1643), making the famous declaration which epitomises that system of absolute monarchy with which the great French King's name is essentially identified.

intellect were withdrawn, many of the young industries began to languish and decay, the navy was again neglected, and colony-planting arrested. Too late it was discovered that, apart from collective enterprise, the State can never take the place of human effort and perseverance, human thought and ingenuity. Yet Colbert must not be held responsible for the appalling unwisdom of Louis' later schemes. His services to France were priceless; but they were ill requited, because he had attacked too many vested interests and hoary abuses, and the people, maddened by the costliness in blood and treasure of Louis' adventures

Louvois was to the Army what Colbert was to the Navy, and his incessant demands for money cruelly crippled many of the pacific Minister's schemes.

Nevertheless, in his own department, Louvois was a zealous and hard-working reformer. Abuses were rife and he resolutely addressed himself to the formidable task of remedy. Much of the Army only existed on paper, though the corrupt nobles hitherto responsible for manning it, had not omitted to exact payment for *les soldats imaginaires*. These and similar scandals called for radical redress. Louvois, therefore, saw to it that the men were actually on

the establishment, were properly fed, received their pay, and wore a distinctive uniform. Obsolete weapons were replaced by up-to-date ones, the bayonet was introduced, hospitals and magazines for stores were established, and the Hôtel des Invalides for wounded and disabled veterans was founded (1671).

On two sides of his character Louis proved very vulnerable. He was a willing victim of the *grande passion*, in the first place, and, in the second, fell—especially in the latter half of his reign, when it exercised a pernicious effect on his policy—under the spell of the Church, for which he came to cherish a superstitious reverence.

First he fell in love with guileless Louise de la Vallière who, Thackeray avows, was the only friend Louis ever had "in the course of his fourscore splendid, miserable years," and who, unwittingly following Hamlet's advice to Ophelia, retired to a nunnery when she had ceased to please.

Madame de Maintenon

Her place was filled by the haughty, domineering beauty, the Marquise de Montespan, who for ten years held the flunkeys at bay until she, in turn, was dethroned by Madame Scarron, the governess of the children the former had borne to the King. In due course Madame was made Marquise de Maintenon. Besides charm of person and engaging manners, she was a decidedly superior woman—something of a prude, it has been said—and prevailed upon Louis to give up the Montespan and become reconciled to his much-wronged wife.

Six months after Maria Theresa died the King married the Marquise privately (1684) and to the end of his days admitted her into his most intimate confidence. Her conduct and views ultimately modified (on the whole for good) the character of the King and Court, but it is not clear that she directly inspired the Revocation of the Edict of Nantes, Louis' most capital crime.

Lord Acton considers that Louis XIV. was "by far the ablest man who was born in modern times on the steps of a throne" and, waiving his absolutism, it is difficult wholly to dissent from this verdict and wholly to endorse it. The misfortune of autocracy is that it must increase, it can never decrease. There were always shoals of sycophants at Court to worship *Le Roi Soleil*, and Louis' absolutism grew by what it fed on. No man, until towards the close of his career, dared warn him of his evil courses.

Yet in the shipwreck of his plans Louis' own culpability was the greatest. It is unjust to saddle subordinates with the responsibility for the colossal mistakes of an absolute monarch, and we are driven to conclude that, when confronted with a crisis of the first magnitude, the King's political judgment and knowledge failed him. On at least three fundamental issues he went disastrously wrong. Had he chosen to bide his time it was within his power to render France—such a France as Colbert dreamed of—not only invincible, but the arbiter of Europe.

To achieve this destiny, however, it was essential to pay as much heed to the navy as to the army, the other branches of the State being also cared for *pari passu*. But he gave the reins to his personal predilections—a thing which a truly wise king would have studiously avoided—and, being himself a soldier, determined upon a career of conquest by land with a view to the enlargement of his territories. As he read the problem this end could only be compassed by an army overwhelmingly strong. So the navy was to play quite a subsidiary part. He did not grasp the all-importance of sea-power to a country situated as France is geographically, and consequently did not realise that his hopes were blasted even in the inception.

Louis' Defects

Similar lack of insight led him into the Dutch War, when it was manifestly to his advantage to have stood well with the United Provinces. Again, it is impossible to suppose that he did not know that Europe would never tolerate any attempt of the Habsburgs to restore so vast an empire as that which Charles V., who united in his own person the crowns of Austria and Spain, had governed. Notwithstanding, dynastic ambition betrayed his judgment and lured Louis into the plan to win the crowns of France and Spain for a Bourbon, himself or another, a project which he never imagined must be equally distasteful to the Powers.

Reference has already been made to the third and gravest of his blunders, the Revocation of the Edict of Nantes, when he deliberately broke a national compact and drove multitudes of men and women to seek the hospitality and security of other lands rather than abandon their faith, and, at one fell blow, destroyed the rapidly-growing industry, commerce, and prosperity of France.

J. A. M.

Continued from page 209

SCIENCES:

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ELECTRICITY AND MAGNETISM.—XXII

Statical Electricity.—Under certain conditions electricity occurs not in the form of a current but as a *stationary charge* situated on some substance so placed that the electricity cannot escape from it. Electricity existing under these conditions is known as *statical* electricity (Greek=standing), or is sometimes called Frictional electricity on account of the method of rubbing substances together in order to produce it.

Experiment 68.—*To produce statical electricity by friction.*

Rub a piece of sealing wax vigorously several times with a piece of warm *dry* flannel. Now bring the wax near but not touching small pieces of light material, such as chopped straw, or minute fragments of paper. The sealing wax attracts the straw or paper, some pieces of which may jump on to the wax. There is a force of attraction between the two substances.

The sealing wax has become charged with electricity on account of its contact with the flannel, the rubbing being necessary to ensure as intimate a contact as possible. *It is the contact of two dissimilar things that has produced the electrification.* The electricity on the wax does not escape from it since sealing wax is a non-conductor, and even if the electricity did escape, it would not flow as a current but would disappear as a sudden discharge through the hand of the person to the earth. The standing charge of electricity attracts the small pieces of straw or paper. Many other substances act in a similar manner.

Experiment 69.—*To produce a charge of electricity on a glass rod.*

Vigorously rub a glass rod, or piece of thick glass tubing, with some dry silk. By means of paper fragments prove that the glass has been electrically excited.

As in the former case the contact of two unlike substances, glass and silk, has produced statical electricity.

Glass rods and glass tubing may be procured from a chemist at a trifling cost. For use in future experiments small pieces of pith, dutch metal, a few little rods of ebonite, and one or two sheets of tin foil should be obtained from an electrician's.

Conductors and Non-Conductors.—The presence of electricity on bodies which have been rubbed together has been known for a very long time. About the period 600 B.C. Thales of Miletus mentioned that amber possessed properties similar to those which we have observed in the case of sealing wax. Much later, in Elizabethan times, a certain Dr. Gilbert found that many other substances behaved in a similar manner when excited by friction. Those substances which he found capable of electrification he named "electrics" after the word *elektron*, the Greek name for amber, hence the derivation of the term electricity. At first sight it appears that some materials are capable of becoming charged with statical electricity, while others are not capable of such electrification.

Experiment 70.—*To observe the effect of rubbing a piece of brass with dry flannel.*

If possible, obtain a small thin cylindrical bar of brass about five inches long from an ironmonger, and rub it with flannel. Bring the brass near some pieces of paper in order to see if it exhibits properties similar to those of excited glass or sealing wax. It does not do so.

Apparently the brass is not charged with electricity, therefore Dr. Gilbert would not have included it in his list of electrics. But is the non-electrification of brass real or only apparent?

Experiment 71.—*To see if brass can be charged with electricity under conditions different from those of the last experiment.*

Insert the brass into a piece of dry glass tubing. Repeat the rubbing process and again test its condition by means of chopped straw, etc. On this occasion the brass exhibits a certain power of attraction for light bodies; in other words it is electrically charged.

What is the explanation of this? In Experiment 70 the metal was in contact with the hand of the person

performing the experiment so that any electricity which may have been produced immediately escaped to earth through the person, since brass, as other metals, is a conductor. In Experiment 71, however, the glass handle prevented the escape of electricity, owing to the non-conducting nature of glass.

If brass should be unobtainable, try the two experiments, using thick copper wire from which the insulating material has been removed.

These experiments teach us that some substances are conducting and others are non-conducting, and further that non-conductors exhibit electrification on their being rubbed with other suitable substances, while conductors must be separated from the person performing the process of electrification by an adequate layer of non-conducting material (i.e. they must be *insulated*) before they can retain a definite charge of electricity.

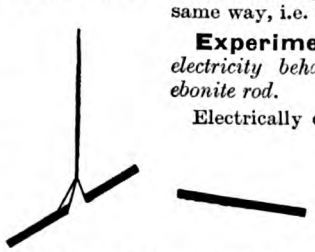


Fig. 78.—To demonstrate the behaviour of two electrically charged ebonite rods.

Evidently all bodies are capable of being electrically excited provided that the necessary conditions are fulfilled, but some exhibit electrical properties in a more marked degree than others do. If we were to perform many experiments with different materials we could classify them in two divisions—conductors and non-conductors. Since the same substance may be non-conducting as far as current electricity is concerned but is a conductor of statical electricity, it may be as well to indicate, in a list, the conducting or non-conducting nature of the more common substances.

Good conductors of *statical* electricity are:—All metals, charcoal, coke, graphite, acids, water and the human body. It should be noted that the last two are non-conductors of current electricity at low voltage.

Cotton, wood, stone and paper are poor conductors, while under the heading of non-conductors we must place :—Glass, silk, sealing wax, paraffin wax, ebonite, rubber, sulphur, wool, oils, shellac and dry air.

Since water, even in the form of a film of moisture, is a conductor, the reason for our using dry flannel, and dry apparatus generally when performing experiments with statical electricity is quite obvious.

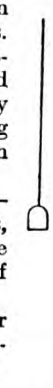


Fig. 79.—To show that when one substance is rubbed by another each becomes charged with electricity, the one positive, the other negative.

Two Electrical States.— Now let us pay further attention to our former experiment with sealing wax and flannel. As the result of the contact of the two substances, were both charged with electricity or only the sealing wax ?

In order to answer the question we must perform a series of simple but interesting experiments.

Experiment 72.—*To charge electrically two ebonite rods and to note their behaviour to each other.*

Rub one of the small ebonite rods with dry flannel and in the usual way show that it is charged with electricity. Being careful not to touch the charged portion of the ebonite rod, suspend it by means of a paper stirrup and a thread of dry unspun silk (Fig. 78). Charge the second rod of ebonite by rubbing it with flannel and bring its charged end near that of the suspended rod. What happens ? There is a force of repulsion similar to that occurring when two like magnetic poles are placed near each other. We may assume that the electricity on one ebonite rod is like that on the other, since they are composed of the same material, and were electrically excited in the same way, i.e. by the same substance.

Experiment 73.—*To see how glass charged with electricity behaves towards an electrically charged ebonite rod.*

Electrically charge a glass rod by rubbing it with a piece of dry silk. In the usual way prove that the glass is charged. Next bring the charged end of the glass rod near but not touching the suspended charged piece of ebonite. There is now a force of attraction between the electricity on the glass and that on the ebonite, and since the two ebonite rods repelled each other, the charge of electricity on the glass must be of a different kind to that on the ebonite.

This experiment shows that *unlike* kinds of electricity exert a force of attraction analogous to that existing between unlike magnetic poles.

Let us see how two pieces of glass electrically excited in the same way behave towards each other.

Experiment 74.—*To notice the behaviour of one glass rod towards another electrified in the same way.*

Rub a glass rod or a piece of glass tubing with silk and suspend it in the paper stirrup. Similarly charge another glass rod or tube and bring its charged end near that of suspended rod (Fig. 79).

Observe the mutual repulsion. Since the two glass rods were charged in the same way, it is evident that the electricity on one rod is the same kind as that on the other. Compare this result with that of Experiment 71. We are now in a position to show that flannel is electrified when it is used in the process of charging a rod of ebonite.

Experiment 75.—*To see if both the substance rubbed and the rubbing material are charged with electricity.*

Make a flannel cap to fit the end of an ebonite rod (or a stick of sealing wax). Attach a strong, dry, silk thread to the middle of the closed end of the flannel cap, place the cap on the ebonite, and wind the thread around the flannel in such a way that the latter rotates when the free end of the thread is firmly pulled. In this way the cap is made to rub the ebonite, and can then be removed by means of the silk thread. Pull the thread and remove the flannel, being careful not to touch either the ebonite or the flannel. Bring the charged end of the ebonite near the suspended flannel and observe if any attraction or repulsion occurs between them.

The results of these experiments teach us certain very important facts in connection with statical electricity, namely :—

(1) There are at least two distinct and unlike

kinds of electricity, one kind produced on ebonite when it is rubbed with flannel, and the other kind produced on glass rubbed with silk.

(2) That charges of the same kind of electricity repel one another, but charges of unlike kinds of electricity attract one another; and

(3) That when one substance is rubbed by another both become charged with electricity, but the electricity produced on the rubbed substance is unlike that on the rubbing material.

Now it can be shown that all bodies when electrically charged either attract or repel a rod of ebonite electrically excited by flannel, and that all those which attract the charged ebonite are repelled by glass electrified by rubbing it with silk. *Hence it is proved that there are only two unlike kinds of electricity, which are, for the sake of convenience, termed Positive electricity and Negative electricity.*

Thus the glass when rubbed with silk is said to be positively charged, while the ebonite rubbed with flannel is considered to possess a negative charge.

According to the modern theories of electricity all substances not electrically excited are considered to possess an equal number of positive and negative electrons (*see* Lesson I) so that one kind balances the other, producing a state of electrical equilibrium. In the process of "charging" a substance such as the glass rod, negative electrons are supposed to leave the glass and go to the silk. Hence the glass has a surplus of positive electrons, while the silk has a similar excess of negative electrons.

The kind of electricity produced on a certain substance by rubbing it with another substance depends upon the nature of *both* substances. Thus, glass rubbed by silk is charged positively, but if fur be used in place of silk, then the fur is positively charged and the glass is negatively electrified. It is possible to arrange the names of suitable materials in a list in such a way that if one substance is rubbed by another whose name is lower on the list, the former will be charged positively and the latter negatively. The following is such a list:—

1. Fur	4. Glass	7. Metals
2. Flannel	5. Paper	8. Sulphur
3. Sealing wax	6. Silk	9. Ebonite

All substances should be thoroughly dried by warming them in front of a fire if good results are to be obtained. L. M. P.

GEOLOGY.—III

Denudation.—ALL the processes which wear down the surface of the earth are grouped together under the general heading of *denudation*. It requires little observation to prove that many agencies are at work in the common task of lowering the surface of the earth. Part of every rain shower percolates through the soil and underlying rocks, and helps to dissolve and break them up.

Every frost shatters the rocks with its wedges of frozen water, just as a lead pipe is burst by the strain of expanding ice within it. Every plant and boring animal loosens the rocks and soils through which it penetrates, and so prepares them for other agents of disintegration, the whole process of rock decay being referred to as *weathering*.

Once loosened and free to move, the weathered rock debris is easily removed from its original position. From high crags on steep mountain sides sharp cornered fragments of all shapes and sizes fall directly by gravity to add to the screes which accumulate on the gentler slopes below.

Every shower of rain carries soil and sand, and even gravel, from higher to lower levels. So the materials reach at last the rivers, which are the most potent agents of removal (Fig. 11). A small mountain stream, clear and sparkling in fine weather, when swollen by heavy rains will become a raging flood, turbid and brown with earthy sediment.

Large pebbles, and even great boulders, are hurried downwards as long as the flood continues. A clear and apparently inactive stream, however, is also helping in the work of transport, for its waters hold in solution carbonates, sulphates, and chlorides of such elements as calcium and sodium.

Deposition.—Sooner or later the transported material is deposited. It may be laid down on the land by the wind as æolian deposits, e.g. sand dunes of the seashore and sand hills of the deserts. Under melting glaciers and around their terminations glacial debris is heaped up. On the floors of lakes lacustrine sands, silts, and muds are gently laid down (Fig. 10). In the bends and over the broad plains of the lower reaches of rivers alluvial sands accumulate. In estuaries and deltas estuarine and deltaic deposits are formed. On the sea floor the coarse beach-gravels and sands merge into the finer sands below low-tide mark, and these in turn pass seawards into muds.

Glaciers, except where running water far down in deep crevasses has sorted out the load of debris, simply dump down whatever material they have gathered up in their journey from the mountains. Wind accomplishes a rough sorting of the sands which it carries before it, according to the size of the grains. Water, however, is constantly engaged in separating different kinds of detrital sediment. Fine mud is carried further than sand, sand further than gravel, and gravel further than boulders. Heavy materials are separated from light because they are less easily buoyed up and carried away. In this fashion heavy minerals, like magnetite, ilmenite, tinstone, zircon, etc., which are only sparsely distributed among

the parent rocks, may become concentrated in river alluvium and beach sands. Moreover, the substances abstracted from the rocks by solution are carried into the sea or into inland lakes, there to be concentrated by direct precipitation—e.g. rock salt and gypsum—or to enter into the hard parts of organisms, and so be ultimately deposited as sheets of calcium carbonate and silica.

The whole process of rock decay and disintegration, of transport, and of deposition results in a more or less complete separation of the original constituents of the rocks. The sandstones, shales, and limestones, and a few other minor types, when taken together in their proper proportions, give a composition which differs but little from the average composition of igneous rocks. The chief discrepancy is in respect of sodium, and that, as we might expect, is accounted for by the salt of the oceans.

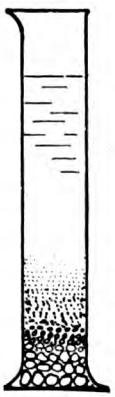


Fig. 10.—To show how gravel, sand and silt are sorted out in still water.

Some Structures of Sedimentary Rocks.—Stratification and lamination have already been mentioned. In sandy rocks which have been laid down under the influence of strong and variable currents in shallow water, *false* or *cross* bedding is very characteristic (Fig. 12). The stratification or bedding is often found to be steeply inclined at various angles; individual beds, instead of being broad, parallel-sided sheets, are seen to be lens-shaped, thinning out rapidly

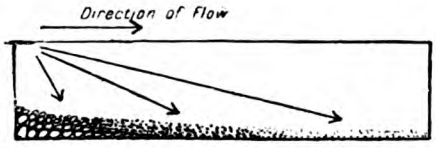


Fig. 11.—To show how gravel, sand and silt are sorted out by running water.

in whichever direction they are traced. Yet, if the whole sandstone formation be viewed, it will be found to be made up of broad bands that lie nearly or quite horizontally. The cross bedding represents the slope on which the sand was dropped; the true bedding represents the upper surface swept clear by the currents.

Wind-blown sands also exhibit cross bedding. Sand is driven before the wind up the slope of a ridge or dune, and on reaching the sheltered lee side it rolls down and comes to rest.

Ripple marks such as are seen at the present day in deserts, between tide marks and on river beds, are found in sandstones of all geological ages. *Sun cracks* are sometimes similarly preserved in ancient rocks. Sun cracks formed at the present day in the muds of shallow tidal waters, which are dried periodically in a blazing sun and seamed with polygonal cracks, are usually obliterated by the following tides. They may, however, exceptionally be preserved when the cracks are filled with sediment. Other structures which record the weather of past ages are *rain prints* and *hail prints*. As far back as geological history can penetrate, these various relics of "fossil weather" are found, eloquent of winds, rains, and sunshine, which differed in no essential respect from those of to-day. Moreover, they indicate in each case the physical conditions under which the beds were being deposited. The trails and burrows of worms, and the tracks of reptiles, birds, and mammals which are sometimes preserved in the silts and muds over which they roamed, are more truly fossils, for although, like the weather records, they are but imprints, they afford valuable evidence of past forms of life.

The Deformation of Sedimentary Rocks.—Although all sandstones, shales and limestones must originally have been deposited in nearly horizontal beds, some of them, especially the older ones, may now

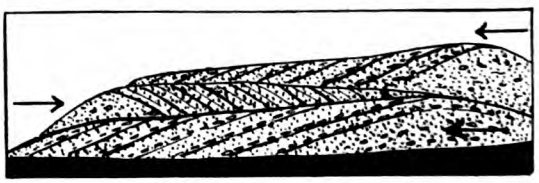
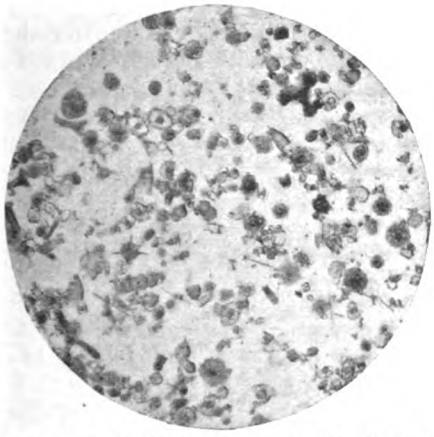
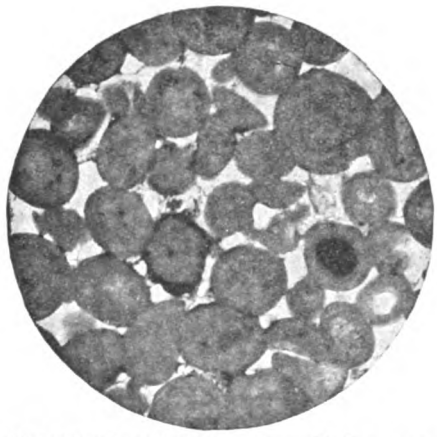


Fig. 12.—Illustrating false bedding, a characteristic of sandy rocks which have been laid down under the influence of strong and variable currents in shallow water. The arrows indicate the direction of currents.

be found tilted at various angles and folded in gentle undulations or in sharp contortions. Fissures and joints break up the continuity of the beds, and there are few districts where the rocks do not exhibit great fractures and dislocations called faults. Folding and crumpling indicate that the rocks have been squeezed by intense forces set up by compression acting within the depth to which the sediments were buried. Fissuring



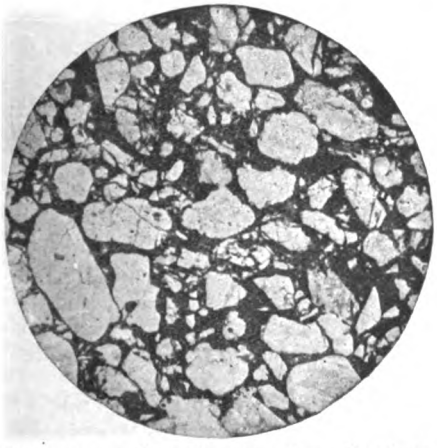
RADIOLARIAN OOZE : from the South Pacific (depth 2,425 fathoms).



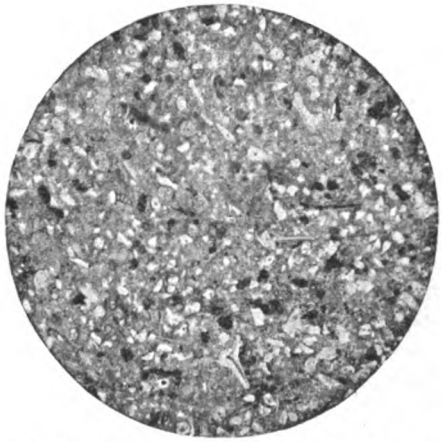
OOLITIC LIMESTONE : from Farley, near Bath.

NUMMULITIC LIMESTONE · from Cairo, Egypt.

FORAMINIFERAL LIMESTONE : from Overend, Cumberland.



FERRUGINOUS SANDSTONE : from Betchworth, Surrey.



GLAUCINITIC SANDSTONE, with sponge spicules and foraminifera : from Betchworth, Surrey.

PHOTOMICROGRAPHS OF SEDIMENTARY ROCKS

as seen in thin sections under a microscope (*Magnification* × 25).

and dislocation may be due to contraction, like the sun cracks of mud flats, but usually they too imply powerful earth movements, sometimes of compression, sometimes of tension, sometimes of twisting.

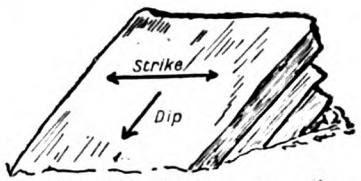


Fig. 13.—To illustrate the directions of "dip" and "strike"

Dip, Strike and Outcrop of Tilted Strata.—When a bed has been tilted from its original horizontal position, the steepest direction down the inclined bedding plane is called the "dip." The angle of the dip is the angle which the steepest direction makes with a horizontal plane. The *dip* of a bed

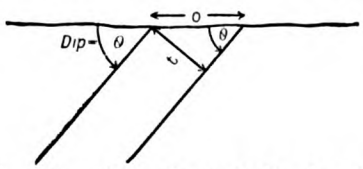


Fig. 14.—When beds dip vertically the width of the outcrops will give the true thickness. For any other angle of dip θ, the width of the outcrop, o, is greater than the thickness, t. The latter is given by the formula, $t = o \sin \theta$.

thus requires two measurements, (1) of the *direction* of maximum slope, which is determined with a compass, and (2) of the angle made with a horizontal plane, which is determined with a clinometer (Figs. 13, 14).

Any horizontal line along an inclined bed is called the *strike*, and it is the direction which the bed would follow if exposed on

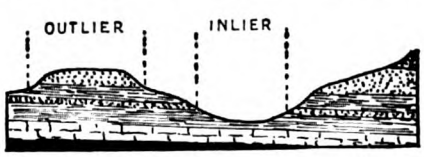


Fig. 15.—Diagram contrasting outlier and inlier.

level ground. The strike is obviously always at right angles to the dip.

If a series of inclined strata come up to the surface on level ground, the latter truncates the edges of the beds, and the space occupied by any bed depends on its thickness and on the dip. The *outcrop* of a bed is the area over which it is exposed at the surface. When the beds are horizontal the outcrop will be greatest, for the level ground will then all be formed by the exposed surface of the uppermost bed. When the beds dip vertically, the width of the outcrops will

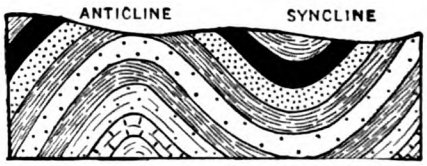


Fig. 16.—An example of folding to illustrate anticline and syncline.

give the true thickness of the beds. For any other angle of dip θ, the width of the outcrop o is greater than the thickness t, which is given by the formula $t = o \sin \theta$.

When the surface of the ground is undulating, the direction of outcrop and strike only coincide when the beds are vertical. If the beds are horizontal the outcrops are

Fig. 17.—An example of monoclinal folding.

determined simply by the contours—i.e. lines of equal elevation above sea level. In the case of tilted beds exposed in a valley, three possibilities present themselves:

(*a*) When the beds dip against the slope of the valley, the outcrop follows a broad or narrow **V**-shaped curve, and the **V** outcrops *up* stream.

(*b*) When the beds dip in the same direc-

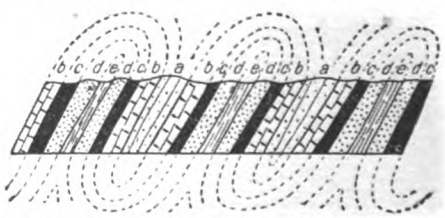


Fig. 18.—Explaining the repetition of beds by isoclinal folding—*i.e.* a succession of overfolds in wnich all the limbs are roughly parallel.

tion as the valley, but at a *lower* angle than that of the valley slope, the **V** outcrops *up* stream.

(*c*) When the beds dip in the same direction as the valley, but at a *higher* angle than that of the valley slope, the **V** outcrops *down* stream.

Sometimes an isolated patch of older strata

is exposed at the surface in such a way as to be surrounded by younger beds; it is then called an *Inlier*. In the reverse case, where an outcrop of younger beds is surrounded by older formations, it is called an *Outlier* (Fig. 15).

Folding of Strata.—Strata are not only found in tilted positions, but also bent into *folds* like sheets of corrugated iron. When the beds are folded up into an arch the structure is called an *anticline*, and the direction of the crest of the arch or ridge is called the anticlinal *axis*. In this case the dip is always away from the axis, but there is a corresponding structure in which the beds are folded into a trough and in which the dips are always towards the axis of the trough. This is called a *syncline*. The sides of a syncline or anticline are referred to as *limbs* (Fig. 16).

A series of beds may be folded into broad and gentle undulations, sharp and compressed contortions, or even into *overfolds*, where a limb has been pushed over beyond the vertical.

Symmetrical folds are those in which the slopes of the limbs of synclines and anticlines are roughly the same. When one side is steeper than the other, the fold is assymmetrical. A strongly assymmetrical fold, in which the strata are suddenly bent from their normal direction to return to it at a different level, is termed a *monoclinal fold*. If an overturned fold or overfold is pushed so far that its limbs become nearly horizontal, the structure is called a *recumbent* fold. A succession of overfolds in which all the limbs are roughly parallel is called *isoclinal* folding (Figs. 17, 18).

Often the axis of folding is not horizontal, but sloping. It is then said to *pitch*, and the direction and angle of pitch are measured from the horizontal plane exactly as in the case of dip.

If an elevation or depression has taken place about a point, instead of an axis, then the beds dip from or towards the point in all directions, and we have the structures known as *domes* and *basins*. These structures are never perfectly circular in section,

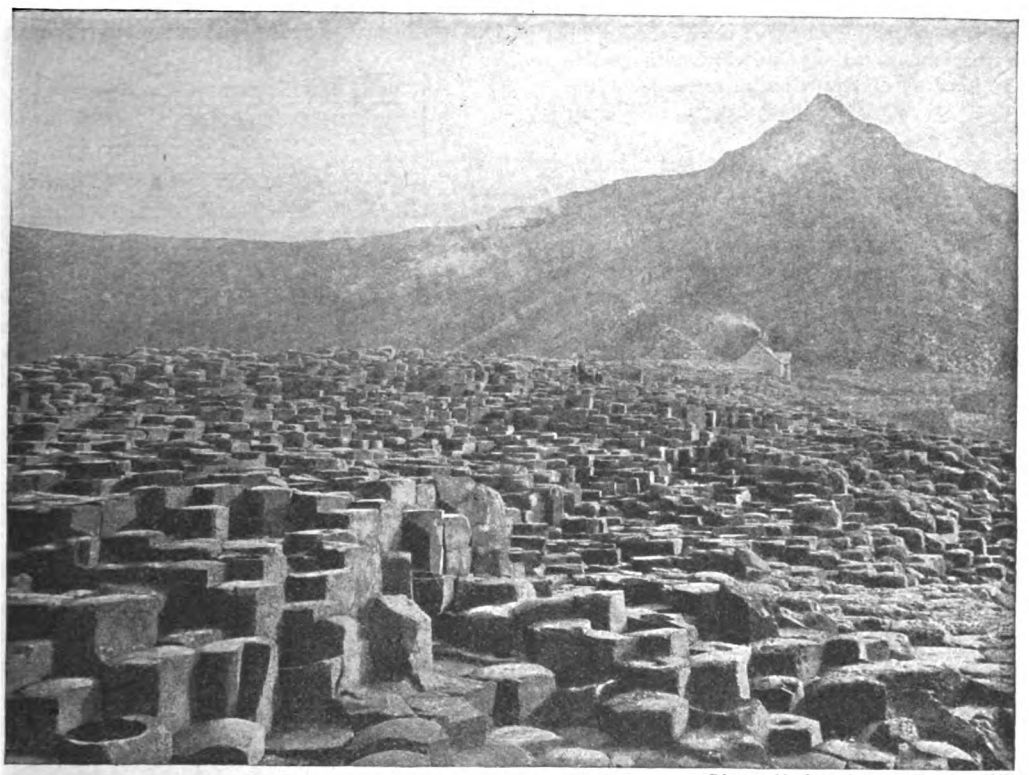


Photo: York and Sons, Notting Hill.

THE GIANT'S CAUSEWAY, IRELAND.

These hexagonal columns of basalt form a striking example of the way in which igneous rocks may be fractured by jointing (see p. 256).

but are generally drawn out in one direction, so that they are really oval-shaped. An anticline, when traced to its limits, is found

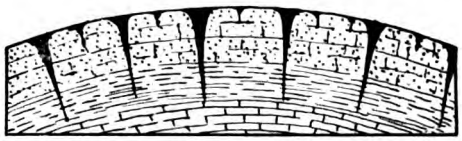


Fig. 19.—Showing joints, or cracks, caused by disruption, *i.e.* the tension which accompanies the bending of strata as in the arch of the anticline here shown.

to be a very elongated dome ; and similarly a syncline is a greatly elongated basin.

Joints. — In addition to the divisional planes of strata determined by their stratification and lamination, the older rocks are often

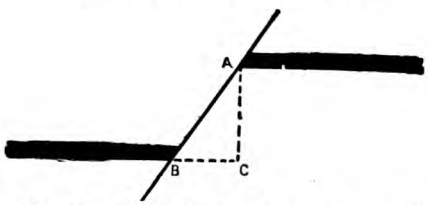


Fig. 20.—A normal fault. It will be seen that the downthrow and hade are both to the left. The angle B A C is the hade of the fault.

found to be traversed by series of cracks and fissures which break them up into separate blocks. These cracks are called *joints*, and in sedimentary rocks there are frequently two sets, each being at right angles to the stratification. Igneous rocks may also be fractured by jointing, the hexagonal columns of the basalts of the Giant's Causeway and of Fingal's Cave presenting famous examples. Joints are due to two causes (Fig. 19) :

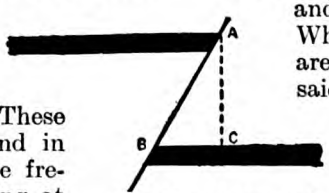


Fig. 21.—A reversed fault, showing up-throw and hade both to the left. Angle B A C is the hade of the fault as in Fig. 20.

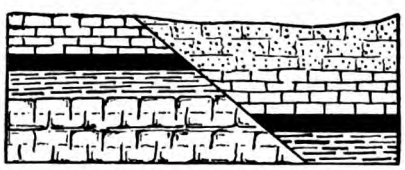


Fig. 22.—Diagram of a normal fault (*cf.* Fig. 23).

(1) **Contraction** of the rocks, by the drying of strata, and by the cooling and crystallisation of igneous rocks.

(2) **Disruption** set up by the tension which accompanies the bending of strata and the uplift of broad areas of the earth's crust.

Faulting of Strata.—A *fault* is a fracture on one side of which the beds are displaced with reference to the corresponding beds on the other side. Since rocks are not very elastic, folding may so strain the rocks that they fracture, and one side is then moved up or down relatively to the other. The fracture may be vertical or, more usually, inclined. In the latter case the inclination from the vertical is called

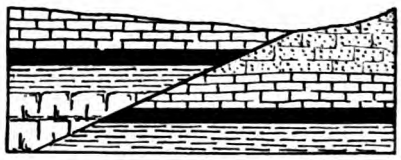


Fig. 23.—Diagram of a reversed fault (*cf.* Fig. 22).

the *hade* of the fault. The amount of displacement measured vertically is the *throw* of the fault, and the amount of displacement measured horizontally is the *shift*. The side which is relatively raised is the *up-throw*, and that which is relatively lowered is the *down-throw*.

When the down-throw and the hade are both in the same direction, the fault is said to be *normal*. In this case a boring or mine could only encounter any given bed once, and it might even miss it altogether. When the down-throw and the hade are in opposite directions, the fault is said to be *reversed*, and in this case a boring might encounter the same bed twice (Figs. 20 to 23). Reversed faults are frequently associated with overfolding, and if the thrusts which are responsible for the movement continue, the broken ends of the same bed may become widely separated, one part riding over the other. When the fault or shear plane is nearly horizontal (so that the hade is very high) it is distinguished as a *thrust plane*.

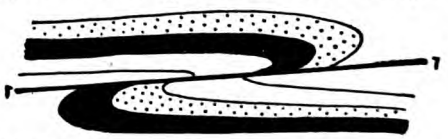


Fig. 24.—An overthrust such as is commonly found in N.W. Scotland and the Alps; a structure resulting from one set of beds being carried over another.

One set of beds may be carried over a lower set for a distance of many miles, and the structure is called an *overthrust* (Fig. 24). In the north-west of Scotland, in Scandinavia,

and in the Alps, overthrusts have occurred on a large scale, bringing old beds from below far away from their original home, so that they now lie on younger beds, giving rise to the most puzzling relationships.

Fig. 25.—An unconformity, *i.e.* a break in the sequence of strata.

The walls of a fault plane are generally polished and scratched by the movement between them, and such smooth or striated surfaces are known as *slickensides*. The fault fissure may be filled with crushed rock called *mylonite* when made up of a fine rock flour,

Fig. 26.—Another example of unconformity (*cf.* Fig. 25). Note that in this case *b* is overlapped by *a*, and that *a* and *b* overstep the tilted beds below.

or *crush conglomerate* or *breccia* when the crushed rock contains rounded or angular masses which have resisted further crushing.

When a fault runs parallel to the strike of the beds, or nearly so, it is termed a *strike fault*. When the fault follows the same direction as the dip of the beds it is

Fig. 27.—An example of unconformity with a fault in the older but not in the younger beds.

a *dip fault*. The outcrop of a fault at the surface—i.e. the line of intersection of the fault plane and the ground—is known as the *course* of the fault.

Unconformity.—Let us imagine that a series of beds is deposited on the sea floor, deeply buried and cemented, and then under the stress of earth-movements folded, or faulted, and raised up above sea-level as a mountain range. It will then be denuded and carved into hills and valleys. If now this land surface is again submerged beneath the sea, a fresh series of deposits will be laid down upon it, in horizontal sheets. The second series of beds will not usually be parallel to the first. Generally, the horizontal beds of the younger rocks will lie over the truncated edges of the older ones, which they are then said to *overstep*. Such a break in the sequence of strata is referred to as an *unconformity*, and the younger series is said to be unconformable to the older (Figs. 25–27).

Slaty Cleavage.—Slates may be split into thin sheets (roofing slates) along planes which are not necessarily, like lamination, parallel to the bedding. This structure, which is called *slaty cleavage*, to distinguish it from the cleavage of crystals, results from the action on fine grained rocks of intense pressures set up by earth movements. All the tiny flakes of minerals of which the slate is made up now lie in the plane of cleavage, and not, as in a shale, in the bedding plane. Cleaved rocks are often contorted, and the strike of the cleavage in such cases is always parallel to the axes of folding. Sometimes the original bedding is entirely obliterated, but usually it can be distinguished by bands of different colour and texture, and by the occasional presence of crumpled and distorted fossils. A. H.

ZOOLOGY.—XXX

THE Tortoises, Terrapins and Turtles constitute the order *Chelonia*. In these reptiles a large bony shell covers the top and bottom of the body so as completely to enclose it. This shell rests upon the vertebræ and the ribs. As a result of this arrangement the shoulders of the tortoise are situated between its ribs. The limbs which carry five toes are adapted for climbing in the case of the tortoise and for swimming in the case of the turtle.

Tortoises and Other Reptiles

Probably the best known of the land tortoises is the *Greek Tortoise*. It measures, when fully grown, about ten or eleven inches in length. The reputation of the Giant Land Tortoise of the Galapagos Islands is, of course, well known to everybody. These great creatures sometimes turn the scale at 800 lb., whilst their age is frequently estimated in prodigious figures.

Terrapins may be distinguished from the true tortoise by the webs which join the toes, and indicate the swimming instinct. The extent to which the terrapin frequents the water varies considerably in the different

species. The Pond Tortoise of Southern Europe is a good example of a life spent probably as much in the one element as in the other.

The Leathery Turtle is the largest of the living *Chelonians*, and sometimes measures six-and-a-half feet from the muzzle to the hind border of the top shell, the length of the shell being about four feet. This armoured monster is found in tropical waters, though in diminishing numbers. The Green Turtle which figures so largely at civic and other banquets is found in the Atlantic, Indian and Pacific Oceans. Weighing sometimes as much as three hundredweight, this turtle is less easily captured, even when on shore, than might be expected. However, when levered on to his back he is helpless, a fact which leads to his undoing. "Tortoiseshell," as sold commercially, is derived generally from the Hawksbill Turtle.

Photo: F. Martin Duncan, F.R.P.S.

COMMON TORTOISE

may be distinguished from the turtle by the fact that the toes of the latter are joined by webs, which indicate the swimming instinct.

All the Crocodiles, Alligators and Gharials are included in the well known and dreaded order *Crocodilia*. These large, four-footed, long-tailed flesh eaters, though fortunately more restricted in their spheres of action than they once were, are still to be found in great numbers both in the New and the Old World.

Of the three groups the crocodiles are the most widely distributed, existing as they do in Africa, Asia and America. The alligators with the exception of a solitary Chinese species, are confined to America and the Gharials are limited to India. Structurally the alligator and the crocodile are very similar. The skull of most crocodiles, however, is narrower than that of the alligator; the crocodile again carries fewer teeth, about fourteen or fifteen, as against anything from seventeen to twenty-two.

There is further a notable point of departure in the fourth lower tooth which is of larger size than its immediate fellows. In the case of the crocodile this tooth fits into a notch in the upper jaw, and is completely visible even when the jaws are closed. In the alligators, on the other hand, this tooth is received into a hole or pit. Active and capable in the water, the members of this order are indifferent pedestrians, though this fact does not prevent them from making more or less prolonged journeys over land from one stream to another.

But the days of these armoured assassins are numbered. In the long dead past Nature itself has fought against them.

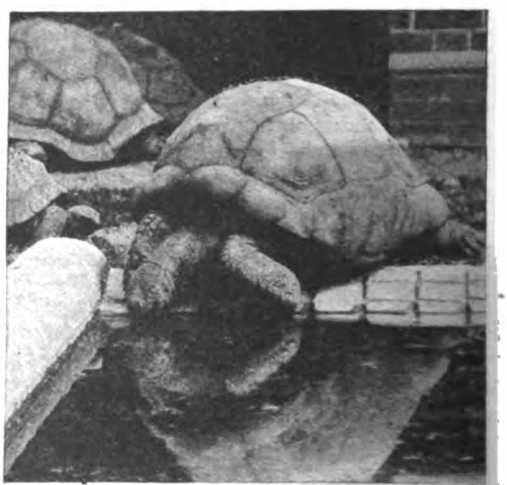


Photo: F. Martin Duncan, F.R.P.S.

THE GIANT LAND TORTOISE

of the Galapagos Islands turns the scales at as much as 800 lbs. and lives to an age estimated in prodigious figures.

There were times, in the days of tropical England, when they scoured the marshes of the Thames: their bones have been discovered in the beds of dried-up watercourses in the Sahara. From there and many other strongholds a changing climate has driven them.

The steamboat and the rifle, moreover, and all that they stand for are fast educating the natives of Africa and Asia, and the crocodile, were he capable of reasoned thought, would long since have realised

that for him and his race the handwriting has already appeared upon the wall.

The true Crocodile, in common with the alligator and the Caiman is distinguished by a short and comparatively broad muzzle and large and stout teeth. The Nile Crocodile sometimes attains a length of twenty feet. The Indian Marsh Crocodile, sometimes called the "Mugger," has a broader muzzle than his Egyptian cousin, but seldom exceeds fourteen feet in length.

The American Alligator is primarily a fish eater, though he does not decline human flesh when he can obtain it without incurring undue risk.

The Gharial of Northern India and the Malay Gharial of Malaysia are characterised by exceptionally long muzzles which are filled by a great number of slender teeth.

Amphibians

Frogs and Toads and their relatives the Salamanders and the Newts form a class termed *Amphibia*. This class, though it comprises individuals of a somewhat lowly order, is actually quite as marvellous as any in the classification of the zoologist. For though other orders may arouse our wonder by the extent to which their abilities and their instincts are in harmony with their circumstances, the Amphibia offers the astounding phenomenon of animals which commence life so thoroughly water-dwellers, that they would expire as surely as any fish if brought to land, but which, nevertheless, before they die become so completely dwellers upon the land that they would drown as surely as any human being if confined for any length of time beneath the surface of the water.

All the mammalia have made this ascent from the water to the shore—but it has taken them millions of years to accomplish it. It has been left for the humble frog and his brethren to perform the same miracle in the course of a single lifetime. And here we have precisely what the scientist means when he speaks of an Amphibian.

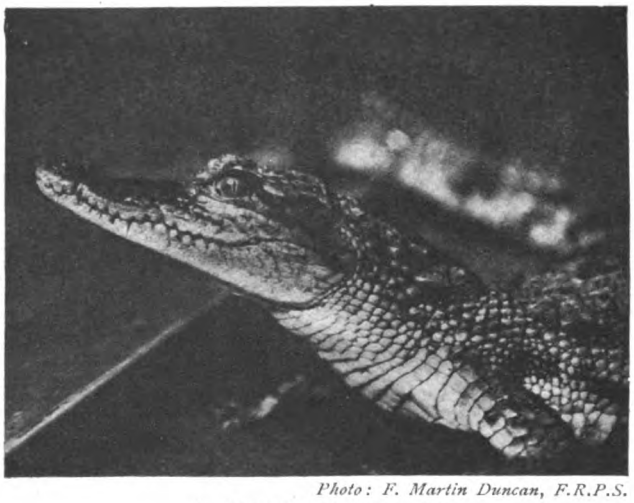


Photo: F. Martin Duncan, F.R.P.S.

A YOUNG CROCODILE,

an armed assassin such as in the days of tropical England scoured the marshes of the Thames.

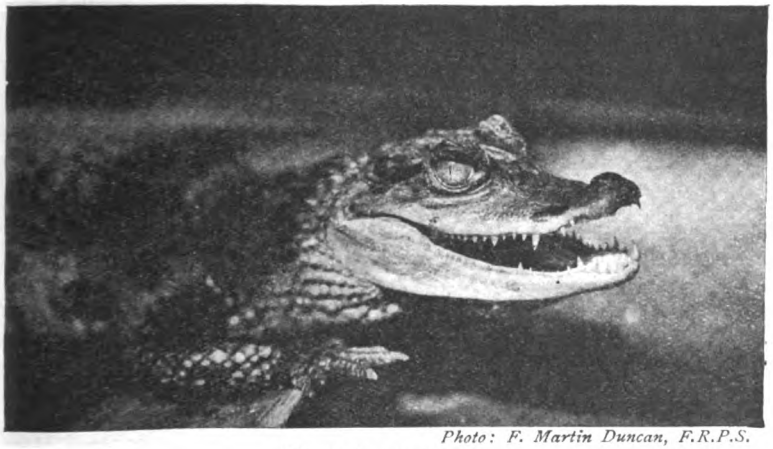


Photo: F. Martin Duncan, F.R.P.S.

THE ALLIGATOR,

with the exception of a Chinese species, is confined to America. Structurally it is very similar to the crocodile.

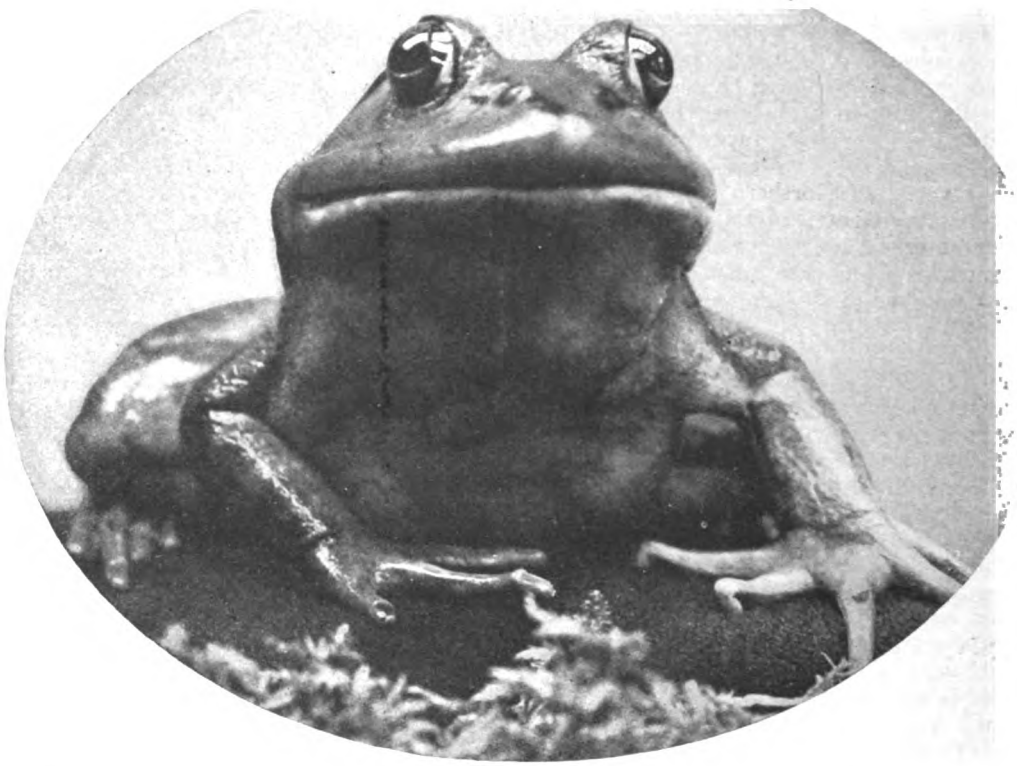
An Amphibian is an animal born in the water, and breathes by external gills, but which ultimately becomes terrestrial and breathes by lungs. This definition, however, should not be too rigidly applied since a few types such as the Olm are permanently aquatic and gill-breathing; it is intended rather to exclude animals such as the hippopotamus which merely divides its time between land and water without undergoing any fundamental change in doing so. For the rest it need only be said that the Amphibians are cold-blooded, that in their

younger days they are vegetarians, and that as adults they are carnivorous.

Frogs and Toads of the order *Anura* are too well known to require detailed description, the order being characterised by the fact that the tail which is a prominent feature of the tadpole is absent in the adult; it has in fact, been absorbed by its owner by way of nourishment during his change of form. Born with a fish-like mouth, breathing in the water through the agency of gills, without limbs, but armed with a useful tail, the tadpole is essentially aquatic. In the course of a few weeks hind legs appear, the external gills are replaced by internal gills, the mouth of the fish gives place to the mouth of the frog, and through the aperture formed by the first gills appear the fingers and arms of the land animal.

But the transformation that has taken place within the tadpole has been no less remarkable than that which has entirely changed his outward shape, for lungs have been developed, and the heart by the expansion of an artery has received a third chamber. Air is now a necessity, and the frog perforce comes ashore.

The Common English Frog is a familiar sight in most gardens where he does useful work in destroying slugs and destructive insects. He is, of course, no more than first cousin to the Green Frog which at the hands of a French cook makes an appetising morsel. The Bull Frog is well known for his lusty voice.



BULL FROG.

An interesting member of an interesting "family." The Amphibians are creatures which, born in the water and breathing by external gills, ultimately become terrestrial and breathe by lungs.

The famous Flying Frog of Borneo has widely extended feet with webbed toes. While the peculiar nature of the feet doubtless assists these animals in their "flight" from branch to branch, they scarcely play the important part that is sometimes ascribed to them.

Darwin's Frog of Chili deserves mention if only for the astonishing practice followed by the male who swallows the eggs of his mate, and duly hatches them in his throat. It is, in fact, from the mouth of the sire that the tadpoles make their first bow to a

world all too little disposed to applaud such freakish performances.

The blunt head and rough skin of the Common Toad were once regarded with suspicion if not dread. Superstition, however, is fortunately losing ground, and it has already, if the figure is allowable, abandoned its attack upon this very useful member of the community. In the garden the toad is of great service in reducing the numbers of caterpillars, slugs and worms. It hibernates during the winter in mud or in some convenient hole or crevice, and has been credited, whether rightly or wrongly the writer does not care to hazard an opinion, with having lived for some centuries embedded in coal and rock. The Natterjack Toad, which is also to be found in England, is shorter in the hind limbs than the common toad and less partial to water. The greatest of his kind, the *Agua* or Giant Toad of Central and South America, sometimes measures six inches in length.

Restoring Lost Limbs

The Salamanders of the order *Modela* are sometimes distinguished by the title Tailed Amphibians, from the fact that they preserve their tails into the adult stage, and this despite the fact that the adult is sometimes a land dweller. In the case of the Giant Salamander of Japan and China, this animal frequently attains a length of five feet. The spotted species exude a poisonous fluid from the skin which acts momentarily as a protection against heat. Otherwise the Salamander is as susceptible to fire as any other animal.

The Common Newt or Evat, in many respects representative of his fellows, takes to the water in the breeding season and hibernates during the winter. The Newt possesses the valuable ability—unfortunately confined to the lowest orders of life—of reproducing lost members of its body. That primitive cry for vengeance "an eye for an eye" would be entirely bereft of justice if directed against a member of this family, since after a short time the eye would be perfectly restored, and the offending newt to all appearances none the worse.

The Olm, already mentioned as purely aquatic, is carnivorous, and haunts in a state of blindness the subterranean caves of the Alps in the districts of Carniola, Dalmatia and Carinthia. It is snake-like in form and sluggish in movement. The Footless Amphibians of the order *Apoda* include a few worm-like creatures to be found in India and Central America. A. B.

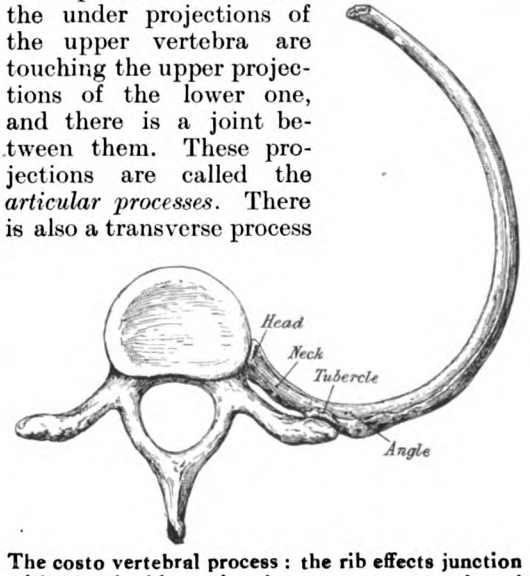
ANATOMY AND PHYSIOLOGY. XI

THE anatomy of the respiratory system is as follows: The skeleton involved is that of the dorsal vertebræ, the ribs and breast-bone and the pectoral girdle; the chief muscles are the diaphragm, the intercostals and some muscles of the neck.

The Organs of Breathing

The organs of breathing are the lungs, with their several parts, and the pleura; and the organs which, among other things, have also to do with breathing are the mouth and nose.

All the vertebræ of the spine, except the two top ones, are made up on the same plan; they consist of a body in front and an arch behind. The body is a small cake of bone, flat on its upper and lower surfaces, convex in front, and generally a little concave behind. The arch projects from its back, and consists of two bony projections, called the pedicles, and two thin flat plates called laminæ, which join together and end in a projection called the spinous process. At the point where the pedicle joins the lamina on each side there is a projection of bone which sticks up from the upper surface, and one which sticks down from the lower surface. When one vertebra is in its place above another the under projections of the upper vertebra are touching the upper projections of the lower one, and there is a joint between them. These projections are called the *articular processes*. There is also a transverse process

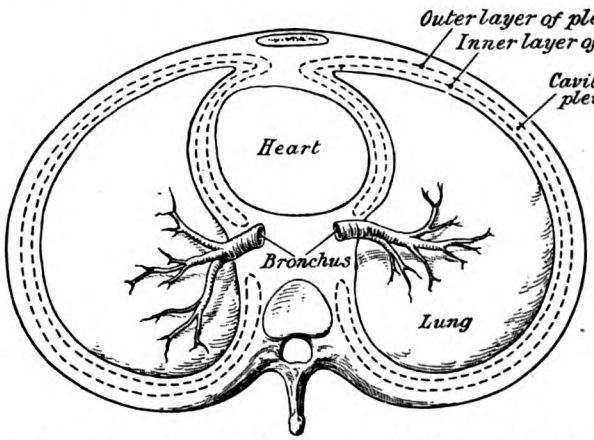


The costo vertebral process: the rib effects junction with the backbone by the processes named, and curves forward to the breast-bone.

on each side, which sticks out just where the articular processes join the pedicle.

The lower five cervical vertebræ in the neck are small, and their transverse processes have a hole in them, through which passes the vertebral artery which enters the skull.

The dorsal vertebræ in the back are larger than the cervical and smaller than the lumbar. The ribs are jointed on to them, sometimes to one alone ; sometimes the head of a single rib is jointed on to a surface which spreads over the edges of two adjoining vertebræ. A dorsal vertebra always has at least one smooth facet on the side of the body close to the pedicle for a rib ; the ribs are also jointed on to the transverse processes.



Horizontal section of the thorax, which consists of a bony-cartilaginous framework (ribs and costal cartilages extending on both sides of the breast-bone and the twelve dorsal vertebræ) and protects the heart and the lungs. The pleuræ are the smooth-walled sacs enclosing the lungs. Note the proportions of the left and right bronchi.

The lumbar vertebræ are larger than the dorsal and have no holes in their transverse processes, nor facets for ribs ; their transverse processes are long and thin, and represent rudimentary ribs.

The nerves pass in and out of the spinal canal under the pedicles of the vertebræ on each side. Between the bodies there are pads of fibro-cartilage, called intervertebral discs.

The ribs are long, curved strips of bone which run from the back-bone to the breast-bone. At the inner end is the head, which is jointed on to the body of the vertebra ; beyond the head is a narrow part, the neck ; beyond this is a rough projection, the tubercle, which is jointed on to the transverse process of the vertebra ; beyond this the rib bends forward at a point called the angle, and finally approaches the breast-bone.

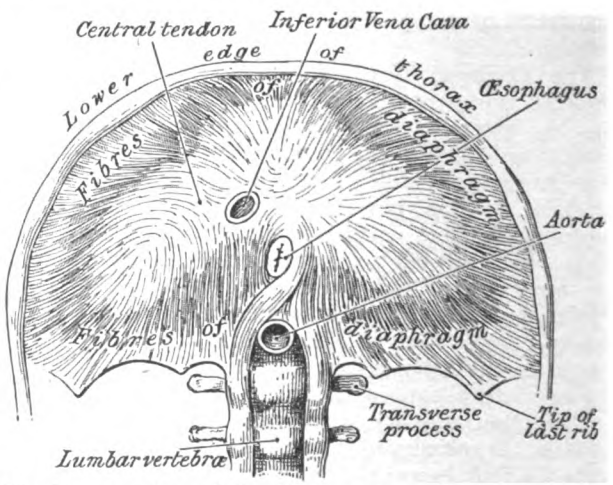
The upper seven are called "true" ribs. They end in strips of cartilage which join the breast-bone. The lower five are called false ribs. The first three end in cartilages which join that of the rib above, the lower two are "floating." The ribs vary in length, getting longer from the first to the seventh, and then shorter from the eighth to the twelfth.

Under the lower edge of the ribs is a groove in which run the intercostal blood-vessels and nerves for the supply of the neighbouring parts.

The sternum, or breast-bone, runs down the front of the chest.

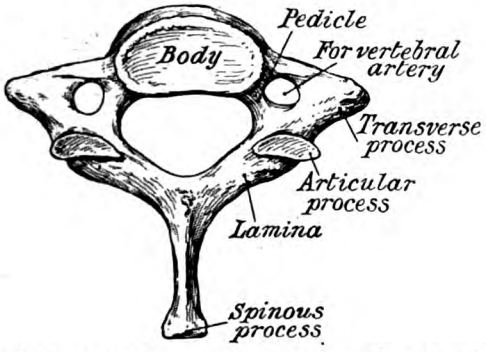
The diaphragm closes the lower end of the thorax ; and since it is the chief part of the bellows mechanism of the chest, it has to be so attached as to form an air-tight partition ; but it also has to provide passages for the aorta and œsophagus going into the abdomen, and for the inferior vena cava going into the chest.

It consists of muscular fibres which rise from the whole of the inner surface of the lower end of the chest, and run inwards to be inserted into the central tendon, which is a large sheet of tendon something like a clover-leaf in shape. The whole diaphragm is a little like an open umbrella. Its fibres run in the direction of the umbrella ribs, and the central tendon is like a large patch in the middle of the dome of the umbrella.



The lower surface of the *diaphragm* in section, showing its relation to the lumbar vertebræ and the lowest rib ; also the passages for the inferior vena cava, which returns most of the blood from the pelvis and lower extremities to the right auricle ; the *œsophagus*, the muscular tube about 9 in. long, extending from the pharynx to the stomach ; and the *aorta*, the main artery of the body.

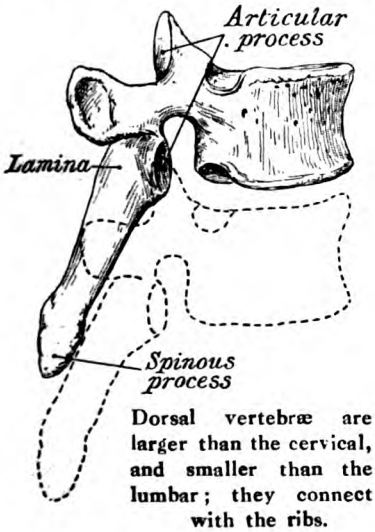
Some of its fibres rise from each of the lumbar vertebræ and form a pillar on each side; these pillars bend inwards and cross one another forming an arch, through which the aorta passes. They then cross again and form a loop before joining the central tendon; through this loop the œsophagus passes. The inferior vena cava passes straight through the tendon itself.



Cervical vertebræ, showing the articular and transverse processes, the projections of the arch known as the pedicles, flat thin plates called laminæ, which, united, end in the spinous process.

Some of the fibres rise from strong tendons which stretch from the pillars to the transverse processes of the first lumbar vertebræ, and from these processes to the last rib.

The intercostal muscles join the ribs together and are attached to the lower border of each rib, except the last, and the upper border of the one below. They form two layers, outer and inner. The external intercostals have fibres running down and forward, and are attached from the tubercles to their cartilages. The internal intercostals run down and back, and are attached from the sternum to the angles of the ribs.



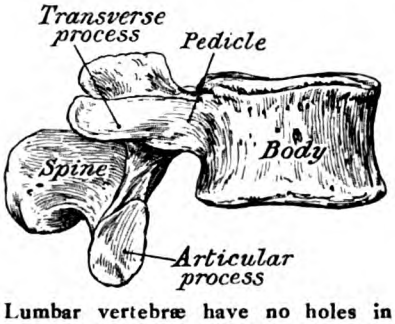
Dorsal vertebræ are larger than the cervical, and smaller than the lumbar; they connect with the ribs.

The *levatores costarum* are little muscles which rise from the transverse processes of one vertebra and run downwards to be inserted into the rib below between the tubercle and the angle.

The above-mentioned are the chief breathing muscles. The muscles first used after exercise, when more breath is required, are the *scalenes*, which are small muscles rising from several of the transverse processes of the vertebræ of the neck; they run down, and are attached to the first and second ribs, near the spine. Being actually attached to ribs they help a good deal to enlarge the chest.

The lungs themselves are the organs which have to contain air, and provide a surface on which the capillaries of the pulmonary circulation can be exposed to this air.

The lungs are internal organs connected with the outside by a passage. The digestive

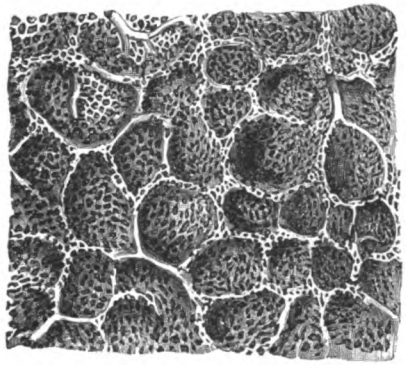


Lumbar vertebræ have no holes in their transverse processes, nor facets for ribs.

system, stomach, intestines, and so on, also consists of internal organs with passages leading outside. The excretory system of kidneys and bladder also connects with the outside. All internal organs which are thus connected with the outside are lined with what is called "mucous membrane." What is "mucus"?

Ordinary spittle is a watery liquid, but not quite like water. It is a little bit sticky, a little bit like a very thin jelly. This is because of the mucus it contains. All over the main surface of these organs which are connected with the outside are glands which secrete mucus. The combined function keeps the inside of the lungs moist, and, in the intestines, lubricates the kidneys. In the kidneys and bladder the cells are probably protected from the effects of waste material.

The *larynx* forms the " Adam's apple " in the throat. It is a case made of cartilage, and contains two little shutters called the vocal cords which can be drawn together and close the entrance to the lungs. In ordinary breathing they are separated for some distance, but when we wish to speak they are drawn close together, and the voice is produced by forcing the breath through the narrow slit so left, which makes the vocal cords vibrate. Also when we cough the larynx is quite closed for a moment, and then burst open by a hard expiration.



Section showing the minute structure of the lungs in the small arteries of the air cells.

Passing between the vocal cords in the larynx the air enters the *trachea*, which is a tube about four and a half inches long, and stretches from the bottom of the neck to the fourth dorsal vertebra. It can be grasped by the thumb and forefinger just above the breast-bone at the lower end of the neck. The tube is made up of arches of cartilage in front and completed by a fibrous membrane behind ; this membrane also lies between the cartilages.

At its lower end the trachea divides into two branches, called the *bronchi*, one for each lung. The right bronchus enters the lung and divides into three branches, one for each lobe. The left bronchus divides into two. The bronchi are similar in structure to the trachea : i.e., made up of pieces of cartilage which are not complete rings in themselves, but arranged round the tube in pieces ; between the latter are muscle and elastic.

Inside the lung the bronchi keep on dividing, getting smaller with each division ; the smaller they get the less cartilage they have, and at last all cartilage is lost and the tubes are made up of muscle : these tubes are called bronchioles.

The bronchioles open out into wider passages made up only of fibrous membrane called *infundibula*. These passages end blindly, and they are studded all over with *alveoli*. In the alveoli the exchange of oxygen and carbon dioxide between the blood and the air takes place.

The great mass of the lungs is made up of these alveoli. They are like a bunch of children's air-balls, packed very closely.

Each lung by itself is a sort of half cone, which fits exactly into one-half of the chest. It is grey in colour. Its outer surface is rounded and fits the chest, its under surface is hollowed out and fits over the dome of the diaphragm, its inner surface is hollowed and fits round the pericardium ; behind the pericardium is a slit, called the *hilum*, through which the bronchi and blood-vessels enter the lung. The right lung is divided into three lobes by two deep clefts through its outer surface, and the left lung into two lobes by a single cleft. A large part of the front of the heart is uncovered by lung owing to a sort of notch taken out of the inner and lower corner of the front of the left lung.

The pleuræ are two bags, one covering each lung. If you cut a body right through the chest at the level of the bronchi you would be able to trace the cut edge of the pleura as follows : Starting at the sternum and going outwards you could follow it round the inside of the chest to the spine, then it would turn forwards till it reached the bronchus. It would follow the bronchus outwards till it reached the lung, and would turn back to the hinder border of the lung, then along its outer side to the front, then back round the pericardium till it reached the bronchus, inwards, and then forwards to the sternum. The space between the pleuræ is called the *mediastinum*.

Minute Structure of the Lungs

If a section is made through the trachea or bronchus, and examined under the microscope, it is seen to be made of fibrous tissue in which the cartilage is embedded. Inside the fibrous tissue is a double layer of involuntary muscle ; both layers are very thin, the outer fibres run longways, and the inner ones round the tube. Inside the muscle is some elastic tissue, and inside of all the mucous membrane. This consists of cells which are called " columnar " ; each is a little column, standing on a narrow base, and having on its free surface little threads or hairs, called " cilia," which are continually in movement, and help to move particles of mucus upwards.

In the bronchioles there is no cartilage, but the involuntary muscle, elastic tissue and ciliated mucous membrane are found. Alveoli consist of flattened cells. D. W. C.-J.

METEOROLOGY.—I

ENCIRCLING the solid earth or Lithosphere is the great gaseous shell known as the Atmosphere. The exact height to which the air extends vertically above the lithosphere is not known, but it is probable that very rarefied air extends considerably beyond 150 miles, since meteorites, or shooting stars, have been observed to fly through the atmosphere at that altitude.

The actual chemical composition of this gaseous shell is properly within the province of Chemistry, but the study of the physical properties of air constitutes the science of Meteorology. The terms meteorite and meteorology are derived from the Greek word *meteoros*, signifying "raised above the earth." Since the climate of any place is the physical condition of the atmosphere at that place, a large section of meteorological science is known as Climatology.

Weather Forecasts

Among the more important atmospheric properties that engage the attention of the meteorologist are the temperatures and pressures of the air at different altitudes, and the distribution of air temperatures and pressures at similar altitudes but over wide geographical areas. It is hardly expressing it too strongly if we say that nearly all the work of a meteorologist is connected, either directly or indirectly, with changes in temperature and pressure taking place in the atmosphere.

Of great importance from a practical standpoint is the correct interpretation of these changes in temperature and pressure, by means of which the meteorologist is enabled to make reasonably correct weather forecasts. In order that such forecasts may be made, observations must be taken at a very large number of meteorological stations, and the results telegraphed to those places where weather maps and charts are prepared.

The recording and mapping of air temperatures and pressures is by no means the only work connected with these two important factors of meteorological phenomena. Many characteristic features of "the weather" are intimately connected with temperature, or with pressure, or with both; and it is a part of the duties of a meteorologist to study these features. Thus, a direct result of changes in temperature of air at different levels is the formation and disappearance of clouds, hence a study of the different classes of clouds, their altitudes, and the kind of weather with which each class is associated is of considerable importance.

It is sometimes possible for a student to make a fairly accurate weather forecast from observations on clouds alone. The meteorologist photographs clouds, measures their altitudes, observes their kind, notes their weather significance, and makes a record of his results. The degree of cloudiness or the "state of the sky," as it is termed, is also noted, and is expressed on charts by means of suitable numerals.

Closely related to the temperature of the air is its *humidity* and its capacity for holding water vapour. If humid, or moist, air be sufficiently cooled, clouds form, and if the cooling process continues rain falls. Systematic and accurate measurement of rainfall and the preparation of rainfall maps is an important branch of meteorological work. The converse of cloudiness is sunshine; and all first-class meteorological stations have an instrument called a sunshine recorder, which not only records the total amount of sunshine on any particular day, but also shows the exact hours at which the sun shone.

Aims of the Meteorologist

In connexion with air pressure a direct result of differences in pressure is the formation of winds. Meteorological work includes the measurement of the velocity and force of the wind besides noting its direction. The movements of winds and *their relation to arrangements of air pressures over wide geographical areas* constitutes one of the most important problems connected with the study of the atmosphere.

Briefly stated the aim of the meteorologist is by accurate and periodic observations on air temperatures, pressures, and atmospheric phenomena closely related to these, to make accurate weather reports and forecasts which are of the greatest importance to the aviator, the mariner, and to many other sections of the community.

The student will have gathered from the foregoing remarks that the daily routine of a meteorologist includes the observation and recording of air pressures, direction and force of the wind, air temperatures, state of the sky, the kind of clouds present, if any, humidity, the rainfall of the previous day, the sunshine of the previous day, and the preparation of weather reports and forecasts, these latter being based upon telegraphic communications from other meteorological stations. In addition, he makes

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Probably the most beneficial of the results obtained by the internationalisation (in 1873) of meteorological observatories has been an appreciable approach to uniformity of method.

observations on the heat received by solar radiation, the heat lost by radiation from the earth, the temperature of the ground, and atmospheric electricity during thunderstorms.

As in the case of many branches of scientific inquiry, such as Electricity or Geology, Meteorology is a modern science, the greatest strides in the subject having taken place during the later portion of the nineteenth century. Since the most noticeable phenomena are generally considered first, the earliest observations of a meteorological nature were concerned with the direction of winds.

The Tower of the Winds at Athens, constructed about 100 B.C., is probably the oldest known means of indicating wind direction. A vane at the top of this octagonal tower indicated in which of the eight directions, recognised at that time, the wind was blowing. No general use of wind vanes came into operation until the middle of the seventeenth century, when they were employed chiefly in Italy and England. About the same time very simple anemometers, or forms of apparatus for measuring the force of winds, were used in Europe, though a very ancient windmill, not unlike a modern cup-anemometer, was discovered in Tibet some years ago.

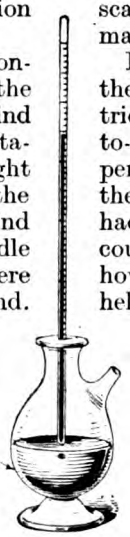

Fig. 1.—Illustrating the principle of the early Italian barometer.

Barometers

The fact that the air has weight, or exerts a pressure, was demonstrated by Galileo, but the barometer was invented by Torricelli in 1643. Early forms of barometers used in Italy consisted of a tube containing mercury, the open lower end of this tube being immersed in mercury contained in an almost closed vessel. Free communication with the atmosphere was made by means of a small aperture in the vessel.

Several patterns of mercurial and aneroid barometers were introduced during the period 1830-1890. Observations on temperatures commenced about the same time as experiments on pressures, and by members of the same little group of Italian investigators, most of them pupils of the illustrious Galileo. Some early thermometers had the tube bent into an arc of a circle, hence the expansion of the liquid due to increase in temperature was expressed by degrees. Early observations concerning humidity were made on the influence of water vapour on strings of musical instruments about the year 1550, but the first systematic researches on hygrometry were made by the famous physicist Boyle about a century later.

The rapid growth of meteorology in the later half of the nineteenth century was not due merely to great improvements in various forms of apparatus, but was very largely the result of co-operation among the numerous workers in different countries. *Modern meteorology is essentially a co-operative science.* The compilation of weather reports and the publication of reliable forecasts can only be accomplished by the co-ordination of the systematic work of hundreds of observers scattered over very large areas embracing many lands.

It is this active co-operation between the meteorological bureaux of various countries that has made the science what it is to-day. Prior to 1872, meteorologists had persevered with observations and records in their own countries, but no serious attempt had been made to connect the work of one country with that of the others. In 1872, however, a meteorological conference was held at Leipzig, and in the following year the International Meteorological Congress was instituted at Vienna. Since that date many international meetings have been held at Rome, Berne, Paris, London, and other important cities.

Meteorological Observatories

Probably the most beneficial of all the results obtained from this international co-operation has been *uniformity of method.* Even at the present time uniformity of expression is incomplete, as shown by the fact that British meteorologists still use Fahrenheit instead of Centigrade readings on temperature maps. On the other hand, the recent expression of air pressures by millibars instead of inches of mercury is a step in the right direction.

Before closing this brief résumé of the growth of meteorological science we must note the changes that have taken place in connection with observatories. In earlier times an observatory was mainly for astronomical purposes, though some meteorological observations were made. At the present time most observatories are either entirely astronomical or entirely meteorological. The number of meteorological observatories has greatly increased, and some have become highly specialised in certain branches of meteorological work. Pre-eminent among these specialised observatories is our own institution at Kew, which has become world famous for its work in standardising instru-

ments, and thus has become one of the prime factors in ensuring that uniformity of method which is so essential to the progress of the science.

In addition to progress in navigation, agriculture, and medical climatology, the modern conquest of the air necessitates a deeper knowledge of atmospheric phenomena. The student who becomes a keen worker

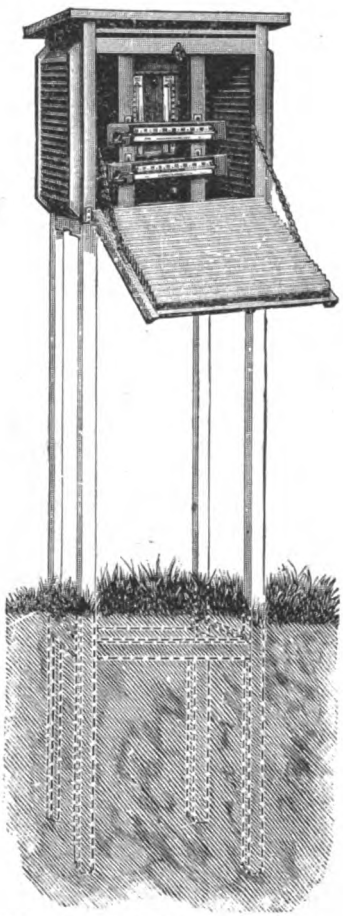

Fig. 2.—The Stevenson Screen.

and acquires accuracy in his observations may give valuable help to the Meteorological Office or to the British Rainfall Organisation.

The Meteorological Office is ready to supply apparatus at cost price to genuine observers who are prepared to forward accurate and periodic reports. It has already been emphasised that accuracy, uniformity of method and co-operation are essential features of meteorological work, and to these must be added perseverance, since long continued observation is necessary if the students' work is to be of service to others.

The physical properties of the air are so closely interrelated that the study of one merges into that of another. It is usual to commence with a consideration of pressure, but since thermometers are less costly and more easily used than barometers we will give first attention to air temperatures and the phenomena which are more closely associated with them.

For practical work the necessary apparatus consists of an ordinary, though accurate, Fahrenheit thermometer, a wet bulb thermometer, and some means of obtaining the maximum temperature of the day and the minimum temperature of the night.

Temperature Readings

A Six's combined maximum and minimum thermometer is useful, but it is better to use separate instruments. The student would do well to refer to the second lesson on HEAT, in which the construction and mode of working of these thermometers are explained (Vol. I., p. 152). The ordinary and the wet bulb thermometers should be mounted vertically and with a space of about one or two inches between them. It is of great importance that all of the thermometers shall be placed in a suitable position in free communication with the atmosphere though properly screened from direct sunshine and from the undue influence of winds.

For serious work the thermometers should be mounted in an arrangement known as the *Stevenson Screen*. This consists of a box the sides of which are louvred, or are made of separated inclined laths somewhat similar to those of a venetian blind: thus the instruments always record "shade" temperatures.

One side of the box is hinged so that the screen may be opened for observational purposes. It is most important that *this hinged side shall face the north* in order to prevent sunshine reaching the thermometers while readings are being made. The screen is supported by four stout wooden legs, the bottom of the box must be three feet six inches above the ground, and the whole arrangement should be painted white in order to conform to the regulations of the Meteorological Office. The student must not regard these regulations as so much red tape, since conformity with them is necessary for purposes of uniformity of method. Even the regulation about white paint is important since the colour of an object has a slight effect on its own temperature and on that of the surrounding air. L. M. P.

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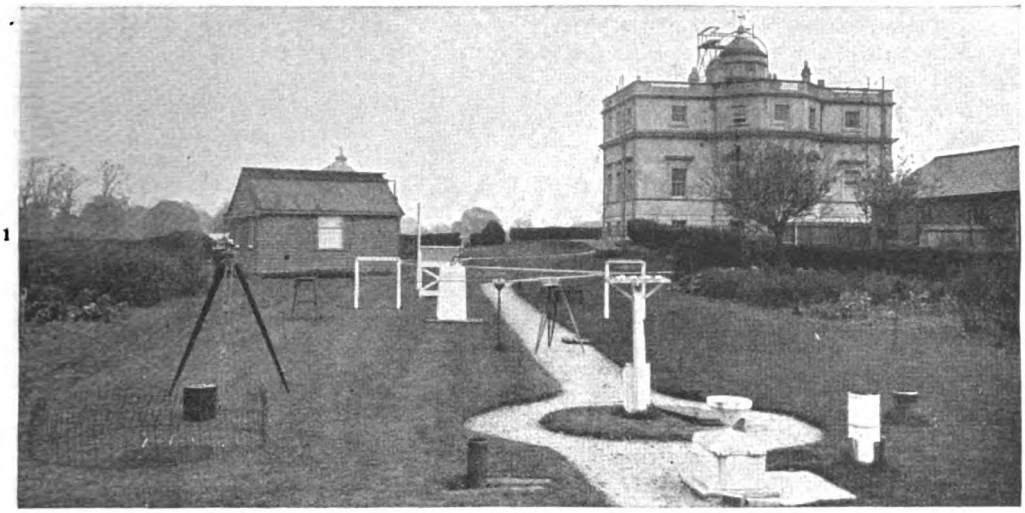

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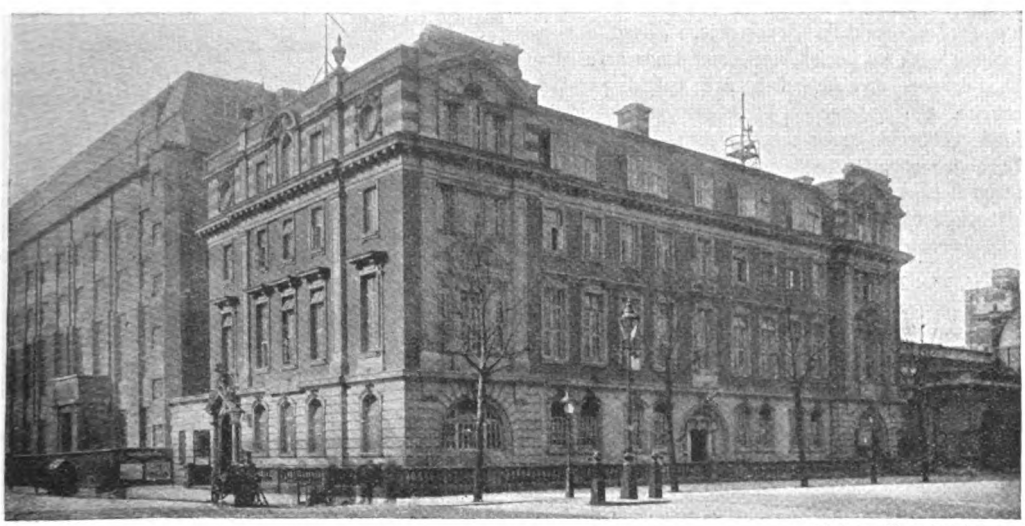


Photos : Pictorial Agency.

G.H.Q. WEATHER.

1. Kew Observatory, showing main building and instruments on the exposure lawn. 2. Another view of the exposure lawn at Kew. 3. The Meteorological Office, South Kensington, London.

Continued from page 221.

LANGUAGES:

***Contributors*:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).**

GREEK.—VIII

Verbs

THE three voices of Greek verbs are exemplified in the following forms of λύω, *I loose*:—

(1) λύω, *I loose*, active;
(2) λύομαι, *I loose myself*, middle;
(3) λύομαι, *I am loosed*, passive.

In the middle voice, to which we have no analogue in English, the action so to speak comes back upon the subject. In other words, the middle voice partakes of both the active and passive signification, since the subject is regarded as both acting and acting upon, or at least as acting for his, her or its own benefit. The middle is identical in form with the passive except in two tenses, the future and the aorist.

Some verbs have no active voice, but are used with an active sense in the middle or passive voice. These are called deponent verbs. Most of them have the aorist and future of the middle form, and are called middle deponents. There are a few others with an aorist, and sometimes a future, of the passive form, which are called passive deponents.

Moods of Greek verbs are the same as in Latin.

There are seven tenses, which may be divided into two classes, primary or principal and secondary or historical tenses, as follows:—

PRINCIPAL TENSES

Present, λύω, *I loose* or *I am loosing.*
Perfect, λέλυκα, *I have loosed.*
Future, λύσω, *I shall loose.*
Future-Perfect, λελύσομαι (passive), *I shall have been loosed.*

HISTORIC TENSES

Imperfect, ἔλυον, *I was loosing* or *I loosed.*
Aorist, ἔλυσα, *I loosed.*
Pluperfect, ἐλελύκη, *I had loosed.*

The essential parts that make up the word in a finite verb are the stem, the personal suffix, and, in secondary tenses of the indicative, the prefix called the augment. Thus the aorist ἔλυσα, *I loosed*, may be split up into the augment ἐ, the stem λυσ- (in this case the aorist stem), and the personal inflexion α.

The two main classes of verbs are those with stems ending in a vowel and those with stems ending in a consonant. Verbs with vowel-stems in all tenses are called pure verbs. Those with stems ending in a mute in all tenses, and those with stems ending in a liquid in all tenses, are called respectively mute verbs and liquid verbs.

The augment assumes three forms, the syllabic, the temporal, and the reduplicative.

The syllabic augment is the vowel prefixed to an initial consonant, as in ἔλειπον, *I was leaving*, from λείπω, *I leave.*

The temporal augment is used with verbs beginning with a vowel or diphthong, which it lengthens or otherwise modifies, the vowels α and ε being changed to η, ει, ῐ and ῠ to ῑ and ῡ, and ο into ω.

In the same way the initial diphthongs αι, ει and οι are changed into ῃ and ῳ.

The reduplicative augment consists in doubling the initial syllable, changing any other vowel to ε, as in λέλυκα from λύω. This is used to form the perfect stem of verbs beginning with a consonant. Verbs beginning with a vowel merely have the temporal augment.

If a verb begins with ρ, the ρ is usually doubled, as in ἔρριπτον from ῥίπτω, *I throw.*

There are two main forms of conjugation in Greek, the first comprehending the great bulk of verbs, those with the first person singular ending in ω, as λύω, *I loose*, and the second comprehending those with the first person singular ending in -μι, as ἵστημι, *I place.*

The Conjugations

I.—VERBS IN ω.

The present stem of a verb in ω is found by taking away the ω of the first person singular of the present indicative active, thus λύω (stem λυ-), λείπω (stem λειπ-), φαίνω (stem φαιν-).

We give in full, as an example of the first class of verbs, those with vowel-stems, the conjugation of the verb λύω, *I loose.* But as the pure verbs do not possess the second tenses (that is, the second perfect and pluperfect active, the second future passive, and the second aorist in all voices), examples of the missing forms are taken from the mute verb λείπω, *I leave*, and the liquid verb φαίνω, *I show.*

ACTIVE VOICE, λύω, *I loose* (stem λυ-)

PRESENT

		Indicative.	*Subjunctive.*	*Optative.*	*Imperative.*	*Infinitive.*	*Participle.*
Sing.	1.	λύω, *I loose* or *am loosing.*	λύω, *I may loose*, etc.	λύοιμι, *I might loose, etc.*		λύειν, *to loose* or *to be loosing.*	λύων, λύουσα, λῦον, *loosing.*
	2.	λύεις, *thou art loosing.*	λύῃς	λύοις	λῦε, *loose thou*, etc.		
	3.	λύει, *he is loosing.*	λύῃ	λύοι	λυέτω		
Dual	2.	λύετον, *you two are loosing.*	λύητον	λύοιτον	λύετον		
	3.	λύετον, *they two are loosing.*	λύητον	λυοίτην	λυέτων		
Plur.	1.	λύομεν, *we are loosing.*	λύωμεν	λύοιμεν			
	2.	λύετε, *you are loosing.*	λύητε	λύοιτε	λύετε		
	3.	λύουσι(ν), *they are loosing*	λύωσι(ν)	λύοιεν	λυέτωσαν or -όντων		

IMPERFECT

Sing.	1.	ἔλυον, *I was loosing* or *I loosed*, etc.
	2.	ἔλυες
	3.	ἔλυε
Dual	2.	ἐλύετον
	3.	ἐλυέτην
Plur.	1.	ἐλύομεν
	2.	ἐλύετε
	3.	ἔλυον

FUTURE (tense-stem λῡσ).

Sing.	1.	λύσω, *I shall loose*, etc.	λύσοιμι, *I would loose*, etc.		λύσειν, *to be about to loose.*	λύσων, λύσουσα, λῦσον, *about to loose.*
	2.	λύσεις	λύσοις			
	3.	λύσει	λύσοι			
Dual	2.	λύσετον	λύσοιτον			
	3.	λύσετον	λυσοίτην			
Plur.	1.	λύσομεν	λύσοιμεν			
	2.	λύσετε	λύσοιτε			
	3.	λύσουσι(ν)	λύσοιεν			

FIRST AORIST (tense-stem λῡσ-)

Sing.	1.	ἔλυσα, *I loosed*, etc.	λύσω, *I may loose*, etc.	λύσαιμι, *I might loose*, etc.		λῦσαι, *to loose* or *to have loosed.*	λύσας, λύσασα, λῦσαν, *having loosed* or *loosing.*
	2.	ἔλυσας	λύσῃς	λύσαις or -ειας	λῦσον, *loose thou*, etc.		
	3.	ἔλυσε(ν)	λύσῃ	λύσαι or -ειε	λυσάτω		
Dual	2.	ἐλύσατον	λύσητον	λύσαιτον	λύσᾶτον		
	3.	ἐλυσάτην	λύσητον	λυσαίτην	λυσάτων		
Plur.	1.	ἐλύσαμεν	λύσωμεν	λύσαιμεν			
	2.	ἐλύσατε	λύσητε	λύσαιτε	λύσατε		
	3.	ἔλυσαν	λύσωσι(ν)	λύσαιεν or -ειαν	λυσάτωσαν or -άντων		

FIRST PERFECT (tense-stem λε-λυ-κ-).

Sing.	1.	λέλυκα, *I have loosed*, etc.	λελύκω, *I may have loosed*, etc.	λελύκοιμι, *I might have loosed*, etc.		λελυκέναι, *to have loosed.*	λελυκώς, λελυκυῖα, λελυκός, *having loosed.*
	2.	λέλυκας	λελύκῃς	λελύκοις	λέλυκε		
	3.	λέλυκε(ν)	λελύκῃ	λελύκοι	λελυκέτω		
Dual	2.	λελύκᾶτον	λελύκητον	λελύκοιτον	λελύκετον		
	3.	λελύκᾶτον	λελύκητον	λελυκοίτην	λελυκέτων		
Plur.	1.	λελύκᾶμεν	λελύκωμεν	λελύκοιμεν			
	2.	λελύκᾶτε	λελύκητε	λελύκοιτε	λελύκετε		
	3.	λελύκᾶσι(ν)	λελύκωσι(ν)	λελύκοιεν	λελυκέτωσαν or -όντων		

FIRST PLUPERFECT

Sing.	1.	ἐλελύκη or -ειν, *I had loosed*, etc.
	2.	ἐλελύκης or -εις
	3.	ἐλελύκει(ν)

First Pluperfect (*continued*)

		Indicative.	*Subjunctive.*	*Optative.*	*Imperative.*	*Infinitive.*	*Participle.*
Dual	2.	ἐλελύκετον					
	3.	ἐλελυκέτην					
Plur.	1.	ἐλελύκεμεν					
	2.	ἐλελύκετε					
	3.	ἐλελύκεσαν					

Second Perfect (tense-stem λελοιπ-)

Sing.	1.	λέλοιπα, *I have left*, etc.	λελοίπω, *I may have left*, etc.	λελοίποιμι, *I might have left*, etc.		λελοιπέναι, *to have left*,	λελοιπώς, λελοιπυῖα, λελοιπός, *having left.*
	2.	λέλοιπας	λελοίπῃς	λελοίποις	λέλοιπε		
	3.	λέλοιπε(ν)	λελοίπῃ	λελοίποι	λελοιπέτω		
Dual	2.	λελοίπατον	λελοίπητον	λελοίποιτον	λελοίπετον		
	3.	λελοίπατον	λελοίπητον	λελοιποίτην	λελοιπέτων		
Plur.	1.	λελοίπαμεν	λελοίπωμεν	λελοίποιμεν			
	2.	λελοίπατε	λελοίπητε	λελοίποιτε	λελοίπετε		
	3.	λελοίπασι(ν)	λελοίπωσι(ν)	λελοίποιεν	λελοιπόντων		

Second Pluperfect

Sing.	1.	ἐλελοίπη, *I had left*, etc.	
	2.	ἐλελοίπῃς	
	3.	ἐλελοίπει(ν)	
Dual	2.	ἐλελοίπετον	
	3.	ἐλελοιπέτην	
Plur.	1.	ἐλελοίπεμεν	
	2.	ἐλελοίπετε	
	3.	ἐλελοίπεσαν or -εισαν	

Second Aorist (tense-stem λιπ-)

Sing.	1.	ἔλιπον, *I left*, etc.	λίπω, *I may have*, etc.	λίποιμι, *I might leave*, etc.		λιπεῖν, *to leave* or *to have left.*	λιπών, λιποῦσα, λιπόν, *having left* or *leaving.*
	2.	ἔλιπες	λίπῃς	λίποις	λίπε, *leave thou*, etc.		
	3.	ἔλιπε(ν)	λίπῃ	λίποι	λιπέτω		
Dual	2.	ἐλίπετον	λίπητον	λίποιτον	λίπετον		
	3.	ἐλιπέτην	λίπητον	λιποίτην	λιπέτωσ̃		
Plur.	1.	ἐλίπομεν	λίπωμεν	λίποιμεν			
	2.	ἐλίπετε	λίπητε	λίποιτε	λίπετε		
	3.	ἔλιπον	λίπωσι(ν)	λίποιεν	λιπέτωσαν or -όντων		

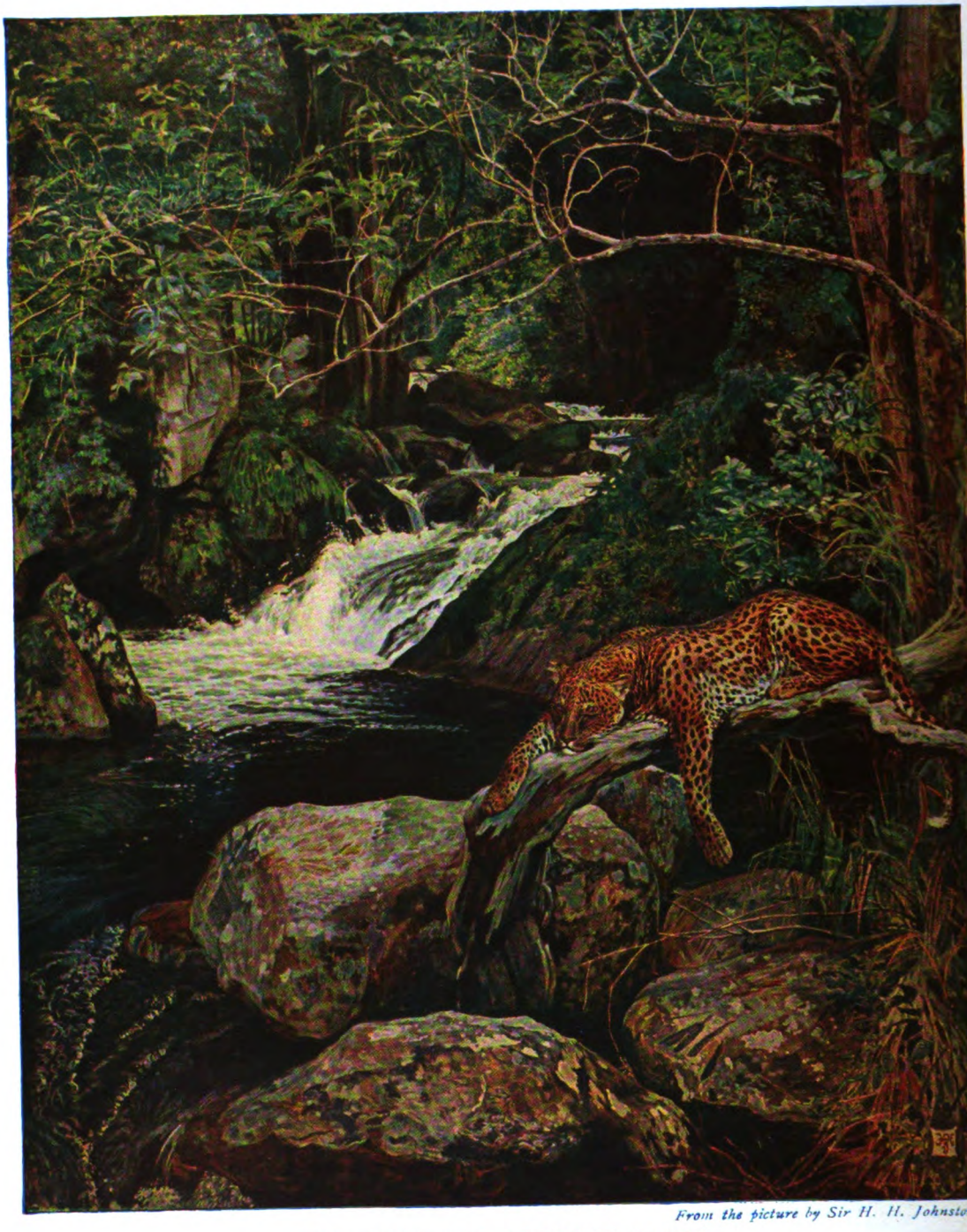
The verbs λείπω, *I leave*, and φαίνω, *I show*, are conjugated like λύω in the present and imperfect. The futures are λείψω and φανῶ; the former is conjugated like λύσω, the latter is given below. The first aorist ἔλειψα is not in good use. The aorist of φαίνω is ἔφηνα, conjugated as below.

Future φανῶ (tense-stem φανε-), *I will show.*

Sing.	1.	(φανέω) φανῶ *I shall show*, etc.	(φανέοιμι) φανοῖμι or (φανεοίην) φανοίην, *I would show*, etc.	(φανέειν) φανεῖν, *to be about to show.*	(φανέων) φανῶν φανοῦσα, φανοῦν, *about to show.*
	2.	(φανέεις) φανεῖς	(φανέοις) φανοῖς or (φανεοίης) φανοίης		
	3.	(φανέει) φανεῖ	(φανέοι) φανοῖ or (φανεοίη) φανοίη		
Dual	2.	(φανέετον) φανεῖτον	(φανέοιτον) φανοῖτον or (φανεοίητον) φανοίητον		
	3.	(φανέετον) φανεῖτον	(φανεοίτην) φανοίτην or (φανεοιήτην) φανοιήτην		
Plur.	1.	(φανέομεν) φανοῦμεν	(φανέοιμεν) φανοῖμεν or (φανεοίημεν) φανοίημεν		
	2.	(φανέετε) φανεῖτε	(φανέοιτε) φανοῖτε or (φανεοίητε) φανοίητε		
	3.	(φανέουσι) φανοῦσι(ν)	(φανέοιεν) φανοῖεν or (φανεοίησαν) φανοίησαν		

Aorist ἔφηνα (tense-stem φην-), *I showed.*

Sing.	1.	ἔφηνα, *I showed*, etc.	φήνω, *I may show*, etc.	φήναιμι, *I might show*, etc.		φῆναι, *to show* or *to have shown.*	φήνας, φήνᾶσα, φῆναν, *having shown* or *showing.*
	2.	ἔφηνας	φήνῃς	φήναις or -ειας	φῆνον, *show thou*, etc.		
	3.	ἔφηνε	φήνῃ	φήναι or -ειε	φηνάτο		
Dual	2.	ἐφήνατον	φήνητον	φήναιτον	φήνατον		
	3.	ἐφηνάτην	φήνητον	φηναίτην	φηνάτων		
Plur.	1.	ἐφήναμεν	φήνωμεν	φήναιμεν			
	2.	ἐφήνατε	φήνητε	φήναιτε	φήνατε		
	3.	ἔφηναν	φήνωσι(ν)	φήναιεν or -ειαν	φηνάτωσαν or -άντων		



From the picture by Sir H. H. Johnston.

THE LEOPARD'S DRINKING PLACE.

A striking representation of a scene actually witnessed by Sir Harry Johnston while prospecting in Nyasaland. The leopard, it should be noted, is Asiatic and African in range, and though smaller than either the lion or tiger, holds a prominent place in the favour of sportsmen. (*See* p. 278.)

The verb φαίνω, *I show*, has first perfect and pluperfect πέφαγκα, *I have shown*, and ἐπεφάγκη, *I had shown* (stem πεφαγκ-) and second perfect and pluperfect πέφηνα, I *have appeared*, and ἐπεφήνη, *I had appeared* (stem πεφην-). It will be good practice for the student to write out these parts in full.

Exercise 8

(*a*) Translate into English :—

1. Ἡ δόξα τῶν παλαίων ἐστὶ κρατίστη. 2. Ὁ χρόνος ἐστὶ σύμβουλος ἄριστος. 3. Τὸ ἀληθέστατόν ἐστι κράτιστον. 4. Ἡ λύπη ἐστὶ κακὸν μέγιστον. 5. Ἐλελύκη. 6. Λυσοίτην.

(*b*) Translate into Greek :—

1. I have loosed or liberated. 2. I shall loose. 3. Thou wouldst loose. 4. I was loosing. 5. They two were loosing. 6. Loose thou.

Key to Exercise 7

(*a*) 1. Good children, love one another. 2. The intemperate is not hurtful to others and useful to himself, but he is hurtful to others and much more hurtful to himself. 3. You gratify yourselves. 4. The avaricious person enriches himself, but injures others. 5. The wise carry their possessions about in themselves. 6. Thy father is good.

(*b*) 1. Ὁ σοφὸς ἐν ἑαυτῷ περιφέρει τὴν οὐσίαν. 2. Φίλων ἔπαινον μᾶλλον ἢ σαυτοῦ λέγε. 3. Γίγνωσκε σεαυτόν. 4. Ὁ βίος πολλὰ λυπηρὰ ἐν ἑαυτῷ φέρει. 5. Ἡ ἀρετὴ καθ ἑαυτήν ἐστι καλή. 6. Οἱ πλεονέκται ἑαυτοὺς μὲν πλουτίζουσιν, ἄλλους δε βλάπτουσιν.

E. A. B.

ITALIAN.—IX

Avere, Éssere, *Future*

Avere, *to have*

Sing.	*Plur.*
avrò, *I shall have*	avremo, *we shall have.*
avrái, *thou wilt have*	avrete, *you will have.*
avrà, *he* (etc.) *will have*	avranno, *they will have.*

Éssere, *to be*

sarò, *I shall be*	saremo, *we shall be.*
sarái, *thou wilt be*	sarete, *you will be.*
sarà, *he* (etc.) *will be*	saranno, *they will be.*

Examples :—

Noi eravamo qui ieri e voi sarete là domani.	*We were here yesterday, and you will be there to-morrow.*
Sarò lieto di sapere il tutto.	*I shall be glad to know all.*
Avremo domattina un libro sui tempi passati (sulle età trascorse).	*We shall have, to-morrow morning, a book on the old times* (past times).
Quando sarete da noi ?	*When shall you be at our house ?*
Si sarà avvicinata la stagione in cúi (nella quale) si danno gli órdini per questi articoli.	*The season will have approached* (drawn near) *in which orders are given* (give themselves) *for these articles.*
Avrà aspettato l'arrivo dell'invío.	*He will have awaited the arrival of the sending* (shipment).
Ci avranno segnato i prezzi delle qualità avute.	*They will have quoted us the prices for the qualities had* (i.e. received previously).
Saremo ritornati a tempo per l'assembléa straordinária della Società.	*We shall have returned in time for the extraordinary meeting of the Company.*
La Società sarà sciolta (sciógliere, *to dissolve, to loose, untie*), essendo spirato il término (per decorso di término).	*The Company will be dissolved through* (owing to) *expiry of term* (i.e. through the effluxion of time, the partnership comes to an end).
Si saranno chieste (from chiédere, *to ask*) informazioni riguardo ai mezzi della casa.	*Information will have been asked for* (lit. informations will have asked for themselves) *with respect to the means of the house.*
Ci saremo stabiliti in questa città come librài editori.	*We shall have established ourselves in this city as booksellers and publishers.*

Quello, *that*

The plural of **quello** as a demonstrative adjective used before a noun beginning with an **s impura** is **quegli**, e.g. quello sconto, quegli sconti.

Quell' is used before a masculine noun in the singular commencing with a vowel, e.g. quell'órdine, plur. quegli órdini.

Quel is employed before a masculine noun in the singular beginning with a consonant, e.g. quel conto, plur. quei conti.

VOCABULARY

tanto tempo, *so long.*
lo speditore, *forwarder* (of goods, etc.).
avere da, *to have to.*
la quantità, *quantity.*
necessario, *necessary.*
pattuíre, *to arrange, stipulate.*
il nolo, *freight.*
l'alunno, *pupil.*
lo scolare, *scholar, pupil.*
la lezione, *lesson.*
molto bene (ben), *very well.*
fra poco, *shortly, soon.*
contento, *content, pleased.*
il panno, *cloth.*
nonchè, *as well as.*
rilevante, *important, considerable.*
la cura, *care.*
terminare, *to end, finish.*
nero, *black.*
venire, *to come.*
la spiegazione, *explanation.*
dettagliare, *to detail.*
assicurare, *to assure.*
moltíssimo, *very much.*
la cámera, la stanza, *room.*
bussate ! *knock !* (imperat.).
promesso, *promised.*
sentitamente, *very much feelingly, sensibly.*
il respiro, *time, breathing time.*
quanto prima, *as soon as possible.*
riscontrare, *to meet, compare, reply to.*
maggiore, *greater, larger.*
l'entità (f.), *size, importance, value.*
bianco, *white.*
il parente, *parent, relative.*
lasciare, *to leave.*
discreto, *discreet, fairly considerable.*
fare assicurare, *to get* (have) *insured, to cause to be insured.*
il premio, *premium.*
la fine, *end.*

trattarsi di, *to treat of, to be a question of.*
il malinteso, *misunderstanding.*
quelli (pl. of *quello*) demons. pron. *those.*
a dovere, *faithfully, properly.*
di prima, *as before.*
crédere, *to believe.*
fra, *between, among, in, within.*
vorrete (from volere), *you will wish.*
compiacersi di, *to be so kind as to.*
acquistare, *to acquire, purchase.*
migliore (adj.), *better.*
méglio (adv.), *better.*
i tessuti, *textiles, woven goods.*
cinquanta, *fifty.*
la banca, *bank.*
nuovamente, *newly, again.*
tornare, *to turn, return.*
pregiato, *prized, esteemed.*
stasera, *this evening.*
píccolo, esíguo, *little, small.*
seicento, *six hundred.*
il metro, *metre.*
giocáre, *to play, to toy, to gamble.*
giglio, *lily.*
gingillare, *to lounge, delay, postpone.*
infrangere, *to infringe.*
marziale (adj.), *warlike, martial.*
mentito, *lying, untruthful.*
onorare, *to honour*
la vísita, *visit.*
il re, *king.*
contenere, *to contain.*
discútere, *to discuss.*
pieno, *full.*
l'esportatore (m.), *exporter.*
scelto, *chosen.*
pronto a (fare), *ready to* (do, make).
concédere, *to grant.*
niuno, nessuno, *nobody, no one.*
a buon mercato, *cheap.*
a miglior mercato, *cheaper.*
la Borsa, *Exchange.*
il luogo, *place.*
comparare, confrontare, *to compare.*
compiegare, *to enclose.*
poco fa, di recente, *lately, recently.*
tostochè, tosto che, *as soon as.*
vívere, *to live.*
assiduamente, *assiduously.*
guadagnare, *to earn.*
greggio, grezzo, *grey, unbleached.*
grigio, *grey* (colour).
Mèssa (f.), *Mass.*
Mèssa cantata, *High Mass.*
Mèssa piana, *Low Mass.*
nano, *small, dwarfish.*
permettere, *to permit, to allow.*
pernice (f.), *partridge.*

Exercise 17

Translate into English :—

1. Avendo avuto molto tempo questo pomeriggio (dopopranzo), abbiamo scritto diverse léttere si clienti sullo stesso soggetto. 2. Mi aveva domandato perchè avevate parlato tanto tempo collo speditore nel magazzino del nostro amico. 3. Perchè avevamo da mandare una quantità di colli a Livorno e ci era necessario pattuire un nolo più basso. 4. Gli alunni (scolari) avévano finito le loro lezioni. 5. Le súe léttere érano state molto ben scritte dall'amico de' (dei) viaggiatori. 6. Abbiamo veduto con piacere dalla vostra dell'otto p.p. (= próssimo passato, *ultimo*) che fra poco avremo l'opportunità di parlare con voi. 7. Siamo contenti (soddisfatti) di questi panni neri e se avrete (future in Italian after *se* and *quando* when referring to future time) la bontà di venire domani da noi, avremo molto piacere di darvi una spiegazione dettagliata. 8. Possiamo assicurarvi che si tratta di un malinteso. 9. Gli scopi della nostra casa son (= sono) sempre stati quelli di servire a dovere i nostri clienti. 10. Siete lo stesso di prima e credo che sempre lo sarete. 11. Sarò pronto fra pochi minuti, se vorrete compiacervi di aspettare. 12. Questi compratori érano più ragionévoli di quelli che avévano acquistato le nostre esistenze di tele gregge (grey, unbleached). 13. Il cotone grigio (colour) era di una qualità molto migliore di quella degli tessuti greggi (or grezzi). 14. Coll'altra léttera ho ricevuto una rimessa di duecento cinquanta (lire) sterline sulla medésima banca. 15. Vi ringrazio nuovamente del (or torno a ringraziarvi pel) favore che avete fatto al mío viaggiatore. 16. La pregiata vostra (léttera) del quíndici scorso è arrivata stamane e sarà nostra cura riscontrarla quanto prima. 17. I miéi órdini sono píccoli (esigui) adesso, ma più tardi saranno più grandi (di maggiore entità). 18. Gl' Inglesi che hanno venduto (or vendute) tutte le loro tele bianche sono venuti da noi iersera. 19. L' Inglese coi suói parenti è venuto il mese passato e ha lasciato un órdine discreto. 20. Gl'Italiani hanno fatto assicurare tutti i loro invíi e hanno pagato il premio prima della partenza del vapore.

Exercise 18

Translate into Italian :—

1. The tickets on the pieces will be very nice, and you will have a good sale of these goods. 2. They have always come at the same time (hour), and have left (departed) three hours later (more late). 3. The year will soon be finished, but the work will be done before then. 4. We and your friends have (1st pers. pl.) visited the same cities in order to buy different (various) articles. 5. The orders contained in the letters received by to-day's post (the post of to-day) are important. 6. We shall have much pleasure in (di) executing your order at very low prices. 7. Our principal will be here to-morrow morning early in order to discuss this subject. 8. Their letters were full of unpleasant remarks about the execution of their orders. 9. In the case of goods received this morning there were several pieces of this same quality. 10. I shall have done this for you before your arrival from Paris. 11. I had not spoken so long with the exporter in my friend's warehouse. 12. They will have chosen the widest pieces (the pieces more wide) in (of) all the lot.

Key to Exercise 8

1. Ho parlato all'avvocato, ma poco mi ha detto di questo affare. 2. I commessi del mío amico hanno scritto tutte le loro léttere per oggi. 3. Hanno spedito per la posta gli importi (gl'importi) delle fatture, defalcando (*or* : meno) lo sconto del diéci per cento giusta gli órdini dei nostri clienti. 4. Un nostro buon' amico di cotesta ci ha favorito il nome della vostra rispettábile ditta. 5. Mi rincresce (Ho il dispiacere) di dovervi dire che i miéi prezzi sonc adesso diéci per cento più cari dell'ordinario ; vogliate, perciò, farmi sapere per posta se posso contare sui vostri órdini. 6. Abbiamo saputo che il nostro agente di Milano vi ha trasmesso il nostro preventivo. 7. A seconda del nostro desiderio, il nostro viaggiatore ha sommesso diversi campioni alla nota ditta di cotesta (costi). 8. Bisogna scrívere súbito e rifiutare la súa offerta. 9. Dite alla ditta che non posso transígere l'affare. 10. Sapete che gli abbiamo domandato di riméttterci una cambiale di cento sterline. 11. Quando avete verificato le súe fatture, cioè, che ha fatto ? 12. Ho ricevuto la loro circolare e ho letto tutte le loro osservazioni con piacere. 13. Essendo rimaste senza risposta le míe léttere del sédici corrente e quattro scorso, non so che fare (risòlvere). 14. Ho diretto i campioni a seconda del desidério manifestato nella (colla) gradita vostra del quattro corrente. 15. Vogliate farci sapere quando avete rimesso il danaro. 16. Vi preghiamo di saldare il nostro conto. 17. Non ho timore (paúra) di non ricévere gli órdini. 18. I nostri ragioniéri dícono che non hanno ancora avuto il tempo di verificare i nostri libri. 19. Dove sono le chiavi degli scrittói de'cassieri ? 20. Mi rincresce che i nostri órdini síano andati ad altri, ma i vostri prezzi son troppo cari (alti).

A. C.

SPANISH.—IX

Subjunctive Mood.—As stated on page 220, the Subjunctive Mood is required after the following :—

(*a*) *Impersonal Verbs.*

Examples

Es prudente que lo haga V. esta mañana.
It is prudent (*advisable*) *that you* (*should*) *do it this morning.*
Es menester (necesario) que tengamos paciencia.
It is necessary that we (*should*) *have patience.*

(*b*) *Negative or Interrogative Verbs.*

¿ Creen Vs. que ellos vengan ? (Pres. Subj. of " venir ").
Do you (plur.) *think that they will come* (or, are coming) ?
No decimos que sea como antes.
We do not say that it is as before.

(*c*) *Emotional Verbs.*

Nos maravillamos que ellos no hayan escrito las cartas.
We are astonished (literally, we marvel ourselves ; Reflexive Verb) *that they have not written the letters.*
Vs. prefieren que yo lo diga (Pres. Subj. of " decir ") pero yo prefiero que Vs. lo digan.
You (plur.) *prefer me to say it* (*that I should say it*), *but I prefer you to say it* (*that you should say it*).

The Subjunctive follows **que,** in case the latter be preceded by any Emotional Verb or expression of emotion, such as are implied under the heads of consent, command, doubt, desire, surprise, want, duty, necessity, regret, fear, apprehension, etc.

The following list includes such verbs :—

aconsejar, *to advise*, i.e. to counsel.
alegrarse, *to be glad.*
avisar, *to advise*, i.e. to notify.
conceder, *to allow.*
consentir, *to consent.*
cuidarse, *to take care.*
decir (only when meaning *to order*).
dejar, *to allow.*
demandar, *to demand.*
desear, *to want.*
dudar, *to doubt.*
esperar, *to hope.*
evitar, *to prevent.*
imaginar, *to imagine.*
impedir, *to prevent.*
intentar, *to intend.*
mandar, *to command*
maravillarse, *to be astonished, to wonder.*
negar, *to deny.*
pedir, *to request.*
pensar, *to think.*
permitir, *to permit.*
persistir, *to insist.*
preferir, *to prefer.*
pretender, *to claim.*
prohibir, *to prohibit.*
querer, *to wish, like.*
reclamar, *to claim.*
regocijarse, *to rejoice.*
rogar, *to entreat.*
sentir, *to regret.*
suplicar, *to entreat.*
suponer, *to suppose.*
temer, *to fear.*

Examples

Aconsejo á Vs. que remitan el dinero.
I advise you to remit the money.
Tememos que sea diferente de lo que ellos dicen.
We fear it is different from what they say.
¿ Piensa V. que haya posibilidad que ejecutemos el pedido (or, posibilidad de ejecutar el pedido) ?
Do you think it will be possible for us to execute the order ?
¡ Permitan Vs. que les digamos una cosa !
Allow us to tell you something (*one thing*).
Me maravillo que tenga V. tanto tiempo para perder.
I am astonished that you should have so much time to lose.
¡ Dígale V. á él que venga aquí !
Tell him to come here.

(*d*) *Superlatives*, when used in a general sense, as :—

Es el mejor mercado que haya en el mundo.
It is the best market there is in the world.

After a Superlative used in a restricted sense, however, the Indicative Mood is required, as :—

Es el mejor de los mercados que tenemos.
It is the best market we have (literally, the best of the markets which we have).

(*e*) *Certain Conjunctions*, viz. :—

á menos, que, salvo que, excepto que, *unless.*
antes que, *before.*
aunque, bien que, *although.*
como, si, *if.*
con tal que, *provided that.*
cuando, *when* (not meaning *whenever*, which takes the Indicative Mood).
de miedo que, *for fear that.*
después que, *after.*
en caso que, *in case that.*
hasta que, *until.*
no obstante que, *notwithstanding that.*
para que, de modo que, afín que, *in order that.*
por más que, como quiera que, *however, however much.*
puesto que, supuesto que, *supposing that.*
sea que, *whether.*
sin que, *without.*

Examples

¡ Escríbannos Vs. para que sepamos qué **hacer** !
Write us, so that we may know what to do.
En caso que el cliente nos confíe el **pedido**, lo ejecutaremos.
In case the customer entrusts us with the order, we shall execute it.
Sin que se haga esto, nada se podrá hacer.
Without (*unless*) *this be done, nothing can be done.*
Por más que yo grite (from gritar), nadie viene.
However much I shout, no one comes.
Aunque (or bien que) lo diga V. no es verdad.
Though you (*may*) *say it, it is not true.* (Here **it** is not certain that the person does say **it.**)
Bien que (or aunque) lo dice V. no lo creo.
Although you (*do*) *say it, I do not believe it.* (Certainty is implied here, therefore the Indicative is used, dice.)
Como ello sea bueno, lo haremos gustosamente.
If it be good, we shall do it with pleasure. (**Como** is rarely used in latter sense.)
Si fuese (or fuera) así, lo sentiría **mucho.**
If it were so, I should be very sorry.
Hasta que (sometimes, **hasta que no venga**) venga su jefe de V.
Until your principal comes.

VOCABULARY

interrumpir, *to interrupt.*
Sud-América, *South America.*
buscar, *to seek, look for.*
arruinar, *to ruin.*
suceder, *to happen.*
inesperado, *unexpected.*
á tiempo, *in time, punctually.*
poner un telegrama, *to send a telegram.*
marcharse, *to go away, leave.*
reflexionar, *to reflect, consider.*
un poquito, *a little bit* (diminutive of poco).
actual (adj.), *present.*
desistir de, *to desist from, give up.*
la intención, *the intention.*
desairar (un giro), *to dishonour* (a draft).
proponer, *to propose.*
el resultado, *the result.*
la presentación, *the presentation.*
encarecidamente, *earnestly.*
deber, *to owe, ought, should, to be one's duty* (to).
el gasto, *the expense, charge.*
faltar (de), *to fail* (to).
el contrato, la contrata, *the contract.*
firmar, *to sign.*
la manera, *the manner, way.*
enterar, *to inform.*
verdadero, *true, genuine.*
la contestación, *the reply, answer.*
prometer, *to promise.*
guardar, *to keep.*
guardar palabra, *to keep one's word.*
él mismo, *himself, he himself.*
mentiroso (adj)., *lying.*
la situación, *the situation.*
seguro (adj.), *sure.*
cierto (adj.), *certain.*
igualar, casar, hacer juego con, hermanar, *to match.*
el libro de caja, *the cash-book.*
la fecha, *the date.*
llevar, *to take, carry.*
lo que, *what, that which.*
la cosa, el asunto, *the matter.*
exponer, *to expose.*

Exercise 15

Translate into English :—

1. ¡ Permita V. que le diga una cosa y no me interrumpa V. ! 2. Los mejores mercados que tenemos son los de Sud-América. 3. Estoy buscando el mejor mercado que haya en el mundo. 4. Sin que V. me dé su palabra, no aceptaré. 5. Estamos arruinadas salvo que suceda algo de inesperado. 6. De miedo que no llegue el correo á tiempo, pondremos un telegrama. 7. Después que hayamos concluido nuestro trabajo, nos marcharemos. 8. Antes que hable V., reflexione V. un poquito en las circunstancias actuales. 9. Como quiera que haya hablado él, no desistiré de mi intención. 10. Puesto que llegue el vapor á tiempo, no será desairado el giro. 11. ¡ Supuesto que yo haga lo que V. me propone. cuál será el resultado ! 12. Con tal que no sean desairados los giros á su presentación, no tendremos nada que temer. 13. ¡ Ejecute V. los pedidos de modo que queden satisfechos los clientes ! 14. Sea que lo paguemos ó no (or Sea ó no que lo paguemos), no le importa á V. 15. No quiere hacerlo, no obstante que se lo haya pedido yo encarecidamente. 16. Cuando V. hace visita á nuestros amigos, debería siempre llevar bastante dinero consigo para sus gastos. 17. Cuando tengamos el tiempo, no faltaremos de hacer lo que V. nos pide (pedir) ahora. 18. Hasta que (or Hasta que no) se me entregue el contrato firmado, no haré nada. 19. He escrito la carta de esta manera, afín que V. quede enterado de mis verdaderos sentimientos. 20. Excepto que recibamos una contestación y á menos que V. prometa de guardar palabra, no consentiremos.

Exercise 16

Translate into Spanish :—

1. However much you try to forward the goods, you cannot 2. It is necessary to prevent him from making (that he makes, Subj.) that mistake. 3. In case you entrust me with your orders, I shall execute them with every (all) care. 4. We do not deny that he wishes to avoid the payment. 5. Whether you say it or not, it is true. 6. You may have the goods at that price, provided you accept our terms. 7. But supposing that our drafts are dishonoured on presentation. What shall we do then ? 8. I want the best quality that it is (may be) possible to procure in the market. 9. They do not wish to do so, although we have (a fact, therefore Indic.) offered them better terms. 10. Though you allow (Pres. Subj. of conceder) them all they want, they will not be satisfied. 11. Unless (without) you send the goods at once, they will leave them at your disposal. 12. We prefer that you know it directly from himself. 13. We entreat you not to believe those lying rumours. 14. He has requested me to go (that I go) to the manufacturer and explain (that I explain) to him the situation. 15. They suppose that it is (be) as you say, but they are not certain. 16. We regret that we have not been able to find anything to match (that may match) your patterns. 17. When you come here again, bring your cash-book with you. 18. Do they think that there is (a) possibility of our receiving (that we receive) the goods before that date ? 19. Whenever you go to see the makers (manufacturers), always take (tr. take always) the designs with you, so that they (may) know what you want (desire). 20. However the matter may be (tr. that be the matter), do not tell him to go and (tr. *to* by á and Infin.) expose the situation to his friend.

Key to Exercise 5

1. Would you order the new designs ? 2. Yes, sir, I should order all the new designs. 3. Did you sell many goods to this firm in the past ? 4. No, we used to sell (sold) very few articles to it. 5. I buy few articles from this house (firm) now, but before I used to buy a fair quantity (enough). 6. We shall much regret not seeing you in (at) our house. 7. He will wish to receive duplicates of the samples (patterns). 8. To-day I want to write a letter to my client. 9. We used to send many packages to them every year. 10. We sell a hundred cases per month to Mr. González. 11. The assets will not allow of the declaration of such a large dividend. 12. I should buy everything from your firm, but I do not know whether your prices would suit me. 13. I shall sell a small quantity of goods. 14. We supply this article to various customers. 15. Before the War, I used to buy a lot in Germany. 16. You would not sell anything at such high prices.

Key to Exercise 6

1. Los clièntes pedirían los nuèvos dibùjos. 2. ¿ Pediríam Vs. tòdos los géneros ? 3. Àntes vendíamos mùchos géneros á èsta càsa. 4. Si Vs. puèden suplìrme èstos géneros, compraré gràndes cantidàdes. 5. Sentiríamos mùcho no ver á Vs. mañàna en nuèstro despàcho. 6. Deseàban recibir duplicàdos de tòdas las muèstras. 7. Escriben mùchas càrtas extranjèras càda día. 8. Le mandaré á V. los dièz bùltos èsta semàna, sin fàlta. 9. Han compràdo èste lòte de géneros á cuàtro penìques el mètro. 10. No podèmos vendèr èste artículo en pequèñas cantidàdes. 11. Nos hàcen ùna remèsa càda mes. 12. Recibía un suèldo tan bàjo que càsi no podía vivìr. 13. Si los prècios sùben, pondrèmos un telegràma á tòdos nuèstros clièntes. 14. Habría puèsto un telegràma á mi clièntе àntes, si hubièse podìdo. 15. Me enviàba las muèstras àntes de los géneros. 16. Compràban mùcho en Alemània àntes de la Guèrra, pèro ahòra còmpran tòdo en Frància.

A. C.

Continued from page 226.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).

ASIA.—V

In our survey of the main drainage basins of Asia we now come to the great southern area of the central highlands. More or less roughly this corresponds to the peninsula of India and those adjacent territories over which the British Government holds sway.

The whole area has very definite boundaries. On the north-west, separating it from Baluchistan and Afghanistan are the Brahui and Suliman ranges which connect with the Hindu Kush on the north, and the Himalaya, running from these mountains towards the south-east. The other boundaries of the region are the Bay of Bengal on the east and the Arabian Sea on the west, thus enclosing a roughly triangular extent of country of an area of about 1,500,000 square miles and containing a population of over 300 millions.

India

India may be divided into three main physical divisions: the high country of the north-west frontier, the plains of Upper India, and the tableland of the Dekkan.

The rivers of the Indian drainage area may be divided into two groups: those draining the northern highlands through the great plains and those draining the Dekkan; from the point of view of size and importance the former coming first.

The streams draining the northern highlands can be divided again into three great systems, those of the Indus flowing into the Arabian Sea, and those of the Ganges and Brahmapootra both flowing into the Bay of Bengal through practically the same delta.

The Indus rises between the Himalaya and the southern edge of the Tibetan plateau. After flowing for about 500 miles in a north-westerly direction it turns sharply to the south near Gilgit and runs through a gorge in the Himalaya, flowing thence over the plains of the Punjab and Sind to its outlet in the Arabian Sea east of Karachi. In its lower course it receives the waters of the Jhelam, Chenab, Ravi and Sutlej. All these rivers, like the Indus itself, flow through the Himalaya and together they form the five rivers which give the Punjab its name (five waters).

It has a course of 1,800 miles and drains with its tributaries a basin of 373,000 square miles. With the exception of Haiderabad at the head of the delta the Indus has no large towns on its banks, for the reason that below Kalabagh, where it finally emerges from the Himalaya, it is perpetually changing its course, the sudden inundations to which it is subject often devastating the country for miles on each side of its banks.

The Ganges and Brahmapootra

The Ganges, unlike the Indus and the Brahmapootra, rises on the seaward slope of the Himalaya. It is formed by the junction of two head streams and flows into the Bay of Bengal after a course of 1,550 miles.

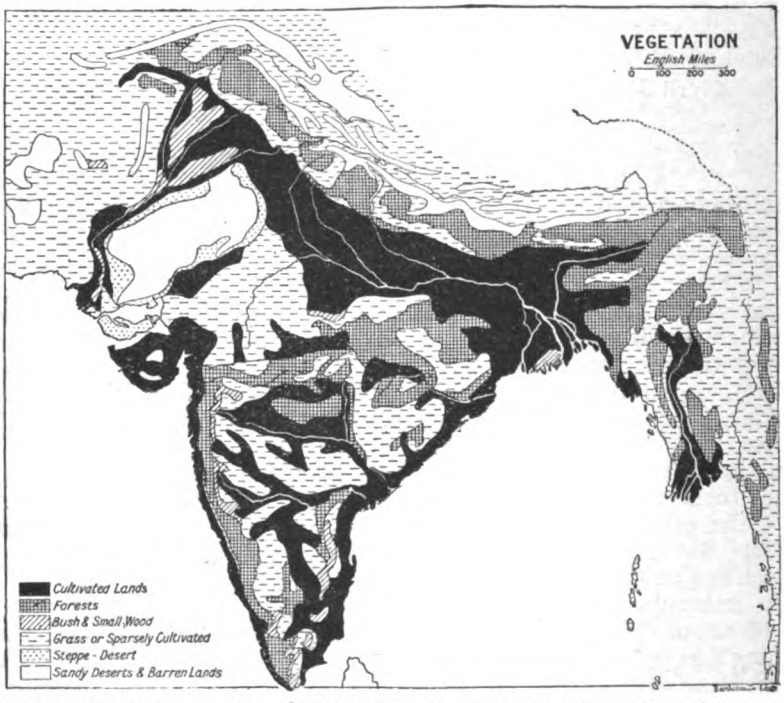
At Allahabad the Jumna joins the Ganges and 140 miles from the sea it unites with the Brahmapootra to form the largest delta in the world. The westernmost branch of the Ganges delta is called the Hugli, upon which stands Calcutta, but the main outlet of the two rivers is called the Megna.

The Brahmapootra, the third great river of India, flows from a great glacier on the north side of the Himalaya and runs east for about 1,000 miles. Then turning south-east it passes through the Himalaya, and runs through Assam, where it flows in a south-west and south direction until it joins the Ganges. Its length is about 1,800 miles and it is navigable for 800 miles from the sea.

The chief rivers of the Dekkan are six in number. Flowing to the west into the Arabian Sea we have the Nerbadda and Tapti; flowing to the east into the Bay of Bengal the Mahanaddy, Godaveri, Kistna and Kavari. The largest of these are the

Godaveri and the Kistna, each between 800 and 900 miles long, and each rising in the Western Ghats.

With the exception of comparatively insignificant portions held by Portugal (Goa) and France (Pondicherry, etc.), India consists of two divisions (*a*) British India



India : showing the areas of cultivation, partly cultivated and uncultivated land

over which the King-Emperor rules, and (*b*) the Native States, subject to British suzerainty but governed by themselves with more or less independence.

British India is divided into thirteen provinces having an area of over 1,000,000 square miles and a population of over 230 millions. The Native States are between 600 and 700 in number with an area of more than 1,000,000 square miles and a population of 71 millions.

Of the whole population of India nearly three-quarters is engaged in agriculture. If the rainfall is deficient, as is sometimes the case, especially in parts of the United Provinces, the Punjab east of the Sutlej, and parts of Rajputana, etc., famine results. The prevention of this is helped by extending the system of artificial irrigation, and alleviation of the distress is effected by improving the means of communication, so that food from districts not famine stricken can be brought into those so afflicted.

The principal crops of India are rice and millet. Other important products are wheat, sugar, tea, coffee, cotton, flax, opium, jute and tobacco.

Of minerals there are found gold (mostly in Mysore), coal, manganese and iron, besides salt, mica and precious stones, chief among which are rubies.

Among the animals of India frequenting the forests and the jungles of the plains are the tiger, leopard, bear, wild boar, rhinoceros and elephant. Deer and antelopes exist in great variety, and there are many fine fleece-bearing goats and sheep, particularly in the western Himalaya. Of reptiles the cobra is the most dangerous to man.

Indian Types

The inhabitants of India belong to many different types, with much variety in the stages of civilisation attained. In the main, however, excluding the European inhabitants, they may be reduced to two main groups: those of Hindu and those of Dravidian stock. The former are mostly found inhabiting the northern plains, the latter the Dekkan. Community of speech, also, is absent from India, for nearly 150 languages are spoken in the peninsula, derived from 20 linguistic families, although it is true that 97 per cent. speak languages derived from three of these families.

The chief religions of India are the Hindu and the Mohammedan which account for 93 per cent. of the population; but there is a considerable number (about 9,500,000) of Bhuddists, principally in Burma, besides other faiths. The institution of "Caste" prevalent among the Hindus originally grouped the people into four main divisions or castes, but it has expanded in the course of time so that some years ago no less than 2,500 main divisions were accounted for in the census returns. The Brahman Caste is the highest, and its members are undoubtedly the aristocracy of the country both physically and intellectually.

Drawn by W. B. Robinson.

HOW EAST AND WEST ARE LINKED.

When the Channel Tunnel and the proposed railway from Baku, on the Caspian, to Nushki, in Baluchistan, have been constructed it will be possible to take passengers and mails by train from London to Bombay in a week. As the above map shows, a shorter alternate route would be by means of a new line from Basra to Karachi, via Aleppo, which may become the Clapham Junction of the East.

India has many great and beautiful cities. One of the most interesting is Delhi, the old capital of the Mogul empire. The modern city, which in 1911 was created the new capital of India, stands among the vast ruins of the old, which cover an area of no less than 20 square miles.

The Ganges valley is rich in large and important towns, among which may be mentioned Agra, Cawnpore, Lucknow and Benares. In Agra is the beautiful mausoleum, the Taj Mahal, a building of exquisite beauty, built by the Mogul Emperor Shah Jehan.

The commercial capital of the Indian Empire is Calcutta which, European and Native cities together, occupies an area of over 15 square miles. Madras on the east coast and Bombay on the west are among the most important of Indian cities, the latter being one of the most, if not the most, flourishing towns in the whole peninsula, having spacious harbours and being generally the first important place touched at by steamers from Europe.

Adam's Peak

India has some 36,000 miles of railway which is directly under the control of the Government. The roads are good and are either maintained by the provincial or district administrations in which they are situated. The rivers and canals account for over 10,000 miles of navigable waterways.

The large island of Ceylon at the south-east extremity of the peninsula is pear-shaped and is naturally almost connected to the mainland by a chain of coral reefs and sandbanks, known as Adam's Bridge. Engineering enterprise has now practically bridged the gap by an extension of South India Railway by a viaduct, one and a half miles long, from Mandapam to Rameswaram Island. The Ceylon line reaches to the extremity of Manar Island, whence the gap of Adam's Bridge is navigated east and west by steam ferries according to the prevalence of the S.W. and N.E. monsoons. The island is mountainous, but very fertile, even in the upland districts, owing to the mildness of the atmosphere and abundance of streams.

Tea, coffee, cinnamon and india-rubber are important products ; precious stones are also found.

The mountain of Adam's Peak is peculiarly revered by Buddhists and Mohammedans, as a rock on the summit is supposed to bear the mark of Adam's foot.

The last great Asiatic drainage basin we have to consider is that of the Euphrates and Tigris valleys. These two great rivers drain nearly the whole of Asia Minor from Syria and Anatolia on the west to the Russian territory and Persia on the east.

The whole of the Mesopotamian basin may be taken as having an area of some 300,000 square miles. The northern section is mountainous, the western portion of this, the Armenian highlands, consisting of a plateau from 4,000 to 7,000 feet high. The eastern part merges into the Caucasian system of mountains where peaks up to 12,000 feet are found, such as Bingol Dagh near Erzerum.

Mesopotamia

The two rivers empty themselves by a common channel into the Persian gulf, the united streams being known as the Shat el Arab from Kurna to the mouth below Mohammerah.

The Euphrates rises in two branches in the mountains of Armenia. Its total length is probably about 1,600 miles. The Tigris also has two head streams rising in the west of the northern highlands, and has a total length of 1,150 miles. Below Bagdad the two streams are connected by several channels.

In the whole of the basin there is only one lake, Lake Van, noted for its beauty and historical interest.

The Mesopotamian river basin consists in the main of two portions, the northern (Diarbekir) consisting of hilly, wooded and grassy steppe country passing into dry desert, which, however, forms productive oases wherever water is found. In the region between Urfa and Haran good crops of cotton, maize, etc., are raised, and lower down the date palm is a prevailing feature in the landscape.

All this land, if properly irrigated and cultivated, would be very productive, but owing to centuries of Turkish misrule the ancient fertility of the land has become almost entirely a memory. Let us hope that under British administration the old productiveness of the land will be revived.

The Persian Gulf, which is the natural outlet of the Mesopotamian basin, has been practically under the care of Great Britain for some centuries, as the greatest part of the trade of the neighbourhood has been in British hands and conducted largely from Bombay.

Piracy and slave-raiding were formerly extremely rife throughout the Gulf district, but these occupations have been sternly suppressed, and the channels of navigation have been surveyed and buoyed. C. J. S.

Continued from page 231.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.
(M. A. Lewenz, M.A.[Lond.]).

MECHANICS.—XII

71. Resolution of Forces.

When a single force is replaced by two or more forces which together would have that single force for their resultant, the force is said to be resolved, and the several resolved parts are called its **components.**

It is clear from the parallelogram of forces that any single force can have two components acting in any number of directions, since the line representing the single force can be the diagonal of any number of parallelograms.

Resolution at right angles.

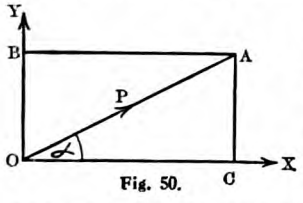


Fig. 50.

Suppose O A represents a force P acting at O. It is often necessary to find two components, one acting along some line O X, making an angle α with O A, and the other acting along O Y which is perpendicular to O X.

Draw A C perpendicular to O X and complete the rectangle O C A B. Then A C, A B represent the two required components.

This is the simplest method of resolution, since neither component has any part in the other.

The resolved part of a force along a given straight line is represented by the projection of the force on that line.

If O X be the given straight line and the given force P be represented by O A.

Draw A N perpendicular to O X.

Then O N and N A represent the forces acting at A whose resultant is O A.

Hence O N is the component of the force P which acts along O X. But O N is the projection of O A on O X, therefore the resolved part of a force along a given straight line is represented by the projection of that force on the line. Let us call this component x.

If P acts along O X, or parallel to O X, then $x = P$.

If P acts at right angles to O X, then $x = 0$.

If P acts at an angle of 60° to O X, then $x = \frac{1}{2}P$.

If P acts at an obtuse angle to O X, then the component x is considered negative. A table of the values of x when P acts in a line making certain angles with O X is given at the foot of this page.

72. *To find the resultant of any number of forces acting at a point in different directions, and in the same plane.*

Take three concurrent forces P_1, P_2, P_3, acting in the same plane. Let them be represented by O A, O B, O C respectively.

Draw XX^1, YY^1 two straight lines cutting each other at right angles at O.

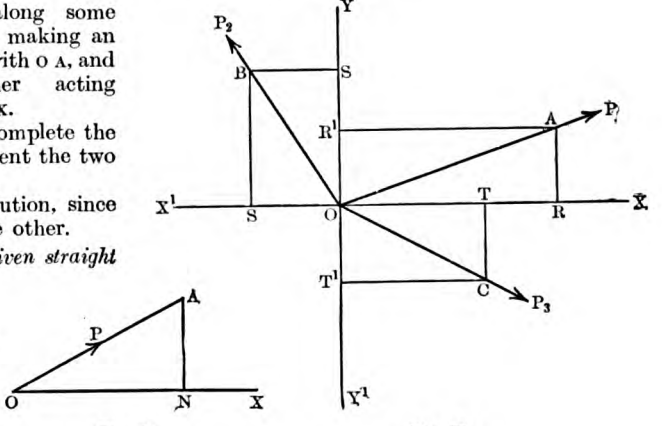


Fig. 52.

Fig. 51.

Let O R, O S, O T be the projections of P_1, P_2, P_3 on XX^1
and O R^1, O S^1, O T^1 be their projections on YY^1.

Angle which P makes with O x	0°	30°	45°	60°	90°	120°	135°	150°	180°
Value of x the component of P along O X	$+P$	$+\frac{\sqrt{3}}{2}P$	$+\frac{\sqrt{2}}{2}P$	$+\frac{P}{2}$	0	$-\frac{P}{2}$	$-\frac{\sqrt{2}}{2}P$	$-\frac{\sqrt{3}}{2}P$	$-P$

Then the three forces may be replaced by O R, O R^1, O S, O S^1 and O T, O T^1.

Now O R, O S and O T act in the same straight line, therefore their resultant x is their algebraic sum. Similarly O R^1, O S^1, O T^1 act in the same straight line, $\therefore$ their resultant y is their algebraic sum.

Thus the forces P_1, P_2, and P_3 are equivalent to two forces x and y acting at right angles, where

$x = OR - OS + OT$ and $y = OR^1 + OS^1 - OT^1$.

The resultant R of these two forces x and y is clearly $\sqrt{x^2 + y^2}$.

Similarly the resultant of any number of concurrent forces in one plane may be found by resolving all the forces along two straight lines at right angles to each other and intersecting at the point where the forces act.

73. Conditions of Equilibrium:

If any number of forces acting in one plane at a certain point are in equilibrium, their resultant must be zero. It follows that the algebraic sum of their components resolved along two straight lines at right angles to one another must be zero or, adopting the notation of § 72, P_1, P_2, P_3, P_4 . . . . will be in equilibrium if $x = 0$ and $y = 0$

74. Equilibrium on an inclined plane.

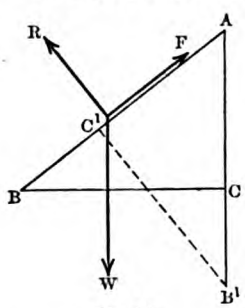


Fig 53.

Suppose a body is kept in equilibrium on an inclined plane by a force F acting parallel to the plane.

There will be three forces acting on the body. The force F, acting parallel to the plane, the force W due to the weight of the body acting vertically downward, and the force R due to the reaction of the plane on the body, which is normal, i.e. perpendicular, to the plane.

Now produce A C to B^1 making A B^1 = A B and draw B^1C^1 perpendicular to A B.

Now F, W and R are in equilibrium, and the sides of the triangle A B^1 C^1 are parallel to the directions in which these forces act

Therefore the sides of the triangle A B^1 C^1, taken in order, represent the forces F, W and R.

Now the triangle A B^1 C^1 is the same in all respects as triangle A B C, i.e. it is triangle A B C turned round into a different position.

Hence we have

$$F : W : R = C^1A : AB^1 : B^1C^1 = CA : AB : BC$$

Hence $\frac{F}{W} = \frac{CA}{AB}$ $\therefore$ $F = \frac{CA}{AB}$ W

or, if the height C A = h and the length A B = l and the base B C = b

then $F = \frac{h}{l}$ W. Similarly $R = \frac{b}{l}$ W.

Next suppose the force F acts horizontally, i.e. parallel to the base of the plane.

Then by producing C A and making C B^1 = C B and producing B C and making C A^1 = C A, we get a triangle A^1B^1C which is the triangle A B C shifted

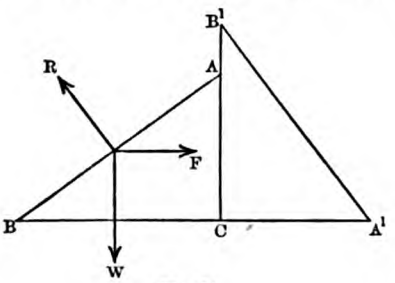


Fig. 54.

round so that its sides are parallel to the directions in which the force F, W and R act, and we have

$F : W : R = CA^1 : B^1C : A^1B = h : b : l$

$\therefore$ $F = \frac{h}{b}$ W and $R = \frac{l}{b}$ W

75. Examples:—

(1) Two men pull a heavy body by ropes inclined to the horizontal at 60° and 30° with forces of 80 lb. wt. and 100 lb. wt. The angle between the vertical planes of the ropes is 30°. Find the single horizontal force that would produce the same effect.

Let O be the body and let O A and O B represent the forces P_1 P_2 along the ropes.

Suppose the vertical plane through O A cuts the ground in the line O X and the vertical plane through O B cuts the ground in O X^1. Then O X, O X^1 are horizontal lines, and the angle A O X = 60° and the angle B O X^1 = 30°

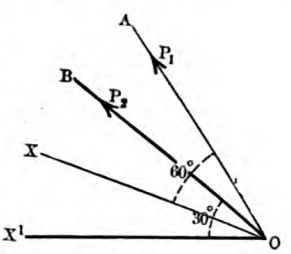


Fig. 55.

x_1 the horizontal component of O A = component of the force P_1 resolved along O X = $\frac{P_1}{2}$

$\therefore$ $x_1 = \frac{80}{2}$ lb. wt. = 40 lb. wt.

x_2, the horizontal component of O B = component of the force P_2 resolved along O x^1 = $\frac{\sqrt{3}P_2}{2}$

$\therefore$ $x_2 = \frac{100\sqrt{3}}{2}$ lb. wt. = $50\sqrt{3}$ lb. wt.

Thus we have found the horizontal components of P_1 and P_2. Now we know that P_1 and P_2 make an angle of 30° with one another. Hence the resultant R_1 of the horizontal components of the forces P_1 and P_2 is given by

$R^2 = P^2 - Q^2 + \sqrt{3}$ P Q (see Lesson XI)

i.e. $x_1^2 + x_2^2 + \sqrt{3}\, x_1\, x_2$

$\therefore$ $R^2 = (1600 + 7500 + \sqrt{3} \times \sqrt{3} \times 50 \times 40)$ lb. wt.

= 15100 lb. wt.

$\therefore$ R = 122·8 lb. wt.

(2) To show how a ship may sail partly against the wind.

Let A B represent a plan of a boat (Fig. 56), O R its sail, W the direction of the relative velocity and strength of the wind. Resolve W into two components along O R and perpendicular to O R. Then

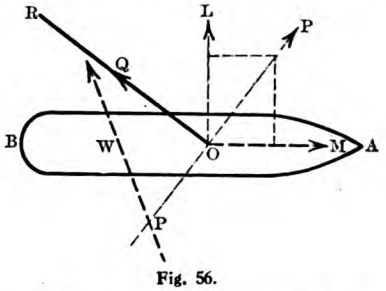


Fig. 56.

the component Q along O R will not help the ship forward—it is known as the *tail wind*. P is the component perpendicular to O R, i.e. the normal pressure on the sail. Now resolve P into two components, one along the direction of the ship's motion, namely M, and the other perpendicular to the direction of the ship's motion, namely L.

The component M causes the ship to move forward.

The component L tends to make the ship move broadside on, and causes it to make what is called *leeway*, but L meets with great resistance and consequently has an almost negligible effect. Hence the ship moves forward in a line very nearly in the direction of its length.

(3) A sphere is attached by a string to a point on a smooth vertical wall, the length of the string being equal to the radius of the sphere. Draw a diagram showing the position of the sphere when in equilibrium and marking the direction of the forces acting on it.

Find the tension of the string if the sphere weighs 10 lb.

Let O be the centre of the sphere, A the point on the wall where the string is attached, C the point on the sphere where the other end of the string is attached, and B the point on the wall where the sphere touches it (Fig. 57).

There will be three forces acting on the sphere, viz.: W its weight, T the tension of the string, R the reaction of the wall on the sphere.

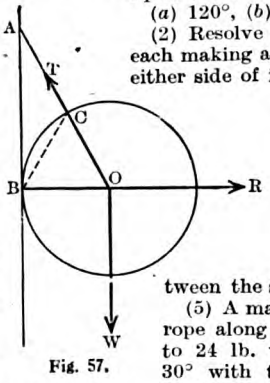


Fig. 57.

Now W acts through the centre O; and since the wall is smooth the reaction R will be normal to the wall and the sphere and will also pass through O.

Since the sphere is in equilibrium the third force T must pass through the same point O, i.e. A C produced passes through O.

Join B C.

Now A B O is a right-angled triangle, and A C = radius of sphere = C O.

$\therefore$ B C = O C = O B

i.e. O B C is an equilateral triangle

$\therefore$ angle A O B = 60° $\therefore$ angle B A O = 30°

i.e. the string makes an angle of 30° with the wall.

Now the sides of the triangle A O B are parallel to the directions of the forces acting at O

$\therefore$ the sides of triangle A O B bear the same ratio to one another as do the forces

i.e. A B : B O : O A = W : R : T

$$\therefore T : W = OA : AB = \frac{2}{\sqrt{3}}$$

$$\therefore T = \frac{2}{\sqrt{3}} W = \frac{2}{\sqrt{3}} 10 \text{ lb. wt.} = \frac{20\sqrt{3}}{3} \text{ lb. wt.}$$

= 11·55 lb. wt.

(4) In a crane A C B, the rod C A is 10 feet long and is connected to the wall by a chain A B, 7 feet long, attached at a point B 5 feet above C. Find T the pull of the chain and F the thrust of the rod when a weight W = 1 ton is hung from A.

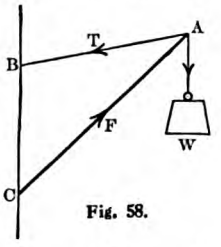


Fig. 58.

The forces acting at A are T along A B, F along A C and W vertically downwards, i.e. parallel to B C.

Hence triangle A B C has its sides parallel to the directions of the forces in equilibrium.

$\therefore$ T : W : F = A B : B C : C A

= 7 : 5 : 10

$$\therefore T = \frac{7}{5} W = \frac{7}{5} \text{ of 1 ton} = 28 \text{ cwt}$$

and $$F = \frac{10}{5} W = 2 \text{ ton.}$$

Exercise 13

(1) Find the resultant of two equal forces each equal to 20 lb. wt. when the angle between them is (*a*) 120°, (*b*) 90°, (*c*) 60°, (*d*) 45°, (*e*) 30°

(2) Resolve a force of 6 lb. wt. into two forces each making an angle of 45° with the given force on either side of it.

(3) If the resultant of two forces acting at a point at right angles to each other be 53 lb., and one of the forces be 28 lb., find the other force.

(4) Find the resultant of forces of 2 lb., 2 lb. and 1 lb. acting at a point, the angle between the first and second being 90° and that between the second and third being 45°.

(5) A man pulls a heavy body by means of a rope along a road. The force he exerts is equal to 24 lb. wt., and the rope makes an angle of 30° with the road. Find the force he would need to apply parallel to the road.

(6) Find the tension in a picture cord, when the two halves of the cord make an angle of (1) 60°, (2) 90°, (3) 120°, with each other. How should one hang a heavy picture so as to get the least tension in the cord?

(7) Draw a diagram showing the forces which keep a kite in equilibrium.

(8) Three forces acting at a point are represented by three adjacent sides of a regular hexagon, taken in order. Find their resultant.

(9) Three flexible strings A, B and C are fastened to a small smooth ring. A and C pass over two smooth

fixed pulleys. If to the free end of A a weight of 9 lb. is attached and to the free end of C a weight of 18 lb. is attached, what weight must be attached to B in order that the forces acting on the ring may be in equilibrium when the angle between A and C = 150° ?

(10) A boat is held fast in mid-stream by two ropes ; one attached to each bank, the ropes being at right angles to each other. If the force of the stream is equal to 500 lb. wt. and the tension in one of the ropes is 300 lb. weight, what is the tension in the other rope ?

(11) A boat is towed straight along a canal by two horizontal ropes, one to each bank. One makes an angle of 60° and the other an angle of 30° with the line of the canal. The pull on the former is 100 lb. ; what is the pull on the latter ?

(Lond. Matric. Exam.)

(12) A cross wind strong enough to exert a pressure of 10 lb. per square foot on a surface normal to its direction acts on a sail of 500 sq. ft. in area, inclined at an angle of 45° to the direction of the wind and to the length of the boat. Find the effective component of the wind pressure on the boat.

(13) A weightless rod 3 feet long is supported horizontally, one end being hinged to a vertical wall and the other attached by a string to a point 4 feet above the hinge ; a weight of 180 lb. is hung from the end supported by the string. Calculate the tension in the string and the pressure along the rod.

(Lond. Matric. Exam.)

(14) A picture weighing 56 lb. is slung over a nail in the ordinary way by a cord attached to two eyes in the top horizontal bar of the frame. If the height of the nail above this bar is half the distance between the eyes, what is the tension in the cord ? Under what circumstances would the tension be equal to or greater than the whole weight of the picture ?

(Lond. Matric. Exam.)

Key to Exercise 12

(1) P $\sqrt{5 + 2\sqrt{2}}$ where P = smaller force. (2) $2\sqrt{61}$ lb. wt. (3) $\sqrt{34}$ lb. (4) $\sqrt{19}$, $\sqrt{13}$, $\sqrt{7}$. (5) $2\sqrt{91}$ lb. wt. (6) $2\sqrt{25 + 12\sqrt{2}}$ lb. wt. (7) $4\sqrt{61}$ lb. wt.

M. A. L.

LOGARITHMS.—IV

11. A WORD of warning is necessary as to the computation of negative characteristics.

When two or more negative characteristics are to be added, we take their sum and make it negative. Thus $\bar{4} + \bar{3} = \overline{7}$

When a negative and a positive characteristic are to be added, we take their difference and make it negative or positive, according as the negative or positive characteristic is greater. Thus $5 + \bar{2} = 3$; and $5 + \bar{7} = -2$.

In adding the mantissae of logarithms or in multiplying them, it must be remembered that anything which is carried to the unit's place affects the characteristic, and that the figure carried is always positive, since the mantissae are always positive.

Examples :—

(1) Add $\bar{2}\cdot7802$ and $\bar{1}\cdot9943$.

$\bar{2}\cdot7802$
$\bar{1}\cdot9943$
$\bar{2}\cdot7745$

We have to carry 1 to the unit's place from the sum of the mantissae, hence the characteristic is $\bar{2} + 1 + 1 = \bar{2}$.

(2) Multiply $\bar{2}\cdot7802$ by 9.

$\bar{2}\cdot7802$
$\times\ 9$
$\overline{10}\cdot0218$

We have to carry 7 to the unit's place from the product of 9 × mantissa. Hence the characteristic is $\bar{2} \times 9 + 7 = 18 + 7 = \overline{11}$.

To subtract a negative characteristic we must add its value. Thus $\bar{3} - \bar{2} = \bar{1}$; $2 - \bar{5} = 7$.

In subtracting one logarithm from the other we must remember that if we have "borrowed" from the unit's place, the amount borrowed must be subtracted from the characteristic.

Example :—

Subtract $\bar{2}\cdot9602$ from 4·0013.

4·0013
$\bar{2}\cdot9602$
$5\cdot0411$

The characteristic will be $4 - \bar{2} - 1$ (since we borrowed 1 from the unit's place in subtracting). $4 - \bar{2} - 1 = 3 - \bar{2} = 5$.

To divide a logarithm with a negative characteristic.

If the characteristic is exactly divisible by the divisor, write down the quotient as a negative characteristic and divide the mantissa by the ordinary rule for dividing decimals. Thus $\bar{6}\cdot3902 \div 2 = \bar{3}\cdot1951$.

If, however, the negative characteristic is not exactly divisible by the divisor, we must increase the characteristic until it is exactly divisible, and prefix a positive integer equal to the increase, to the mantissa. Then we divide in the ordinary way.

Example :—

Divide $\overline{11}\cdot7356$ by 7.

$\overline{11}\cdot7356 = \overline{14} + 3\cdot7356$

$14 \div 7 = \bar{2}$; $3\cdot7356 \div 7 = \cdot5337$

$\therefore\ \overline{11}\cdot7356 \div 7 = \bar{2} + \cdot5337 = \bar{2}\cdot5337$.

12. Examples of the use of logarithms.

(1) Find the product of $7\cdot005 \times 6471 \times \cdot00164$

$\log (7\cdot005 \times 6471 \times \cdot00164) = \log 7\cdot005 + \log 6471 + \log \cdot00164$.

From the Table on p. 230 we have :—

$\log 7\cdot005 = \cdot8454$
$\log 6471 = 3\cdot8110$
$\log \cdot00164 = \bar{3}\cdot2148$
$\overline{1}\cdot8712$

and from the Table (p. 231) $1\cdot8712 = \log 74\cdot33$.

Hence $7\cdot005 \times 6471 \times \cdot00164 = 74\cdot33$.

(2) Find $6471 \div \cdot00164$

$\log \left(\frac{6471}{\cdot00164}\right) = \log 6471 - \log \cdot00164$

$\log 6471 = 3\cdot8110$
$\log \cdot00164 = \bar{3}\cdot2148$
$6\cdot5962 = \log 3947000$

$\therefore\ 6471 \div \cdot00164 = 3947000$.

(3) Find a fourth proportional to 634·5, ·01472 and 9054.

Let x be the fourth proportional, then

$$x = \frac{\cdot01472 \times 9054}{634\cdot5}$$

$\therefore\ \log x = \log \cdot01472 + \log 9054 - \log 634\cdot5$

$\log \cdot 01472 = \bar{2}\cdot 1679$
$\log \quad 9054 = 3\cdot 9568$
$\overline{2\cdot 1247}$
$\log 634\cdot 5 = 2\cdot 8024$
$\overline{1\cdot 3223} = \log \cdot 2100.$

Hence the fourth proportional is **·2100.**

(4) Find $(7\cdot 204)^3$

$\log (7\cdot 204)^3 = 3 \log 7\cdot 204$
$\log 7\cdot 204 = \cdot 8575$
3
$\overline{2\cdot 5725} = \log 373\cdot 7$
$\therefore (7\cdot 204)^3 = \mathbf{373\cdot 7.}$

(5) Find $\sqrt[3]{7\cdot 204}$.

$\log \sqrt[3]{7\cdot 204} = \frac{1}{3}$ of $\log 7\cdot 204 = \frac{1}{3}$ of $\cdot 8575$
$= \cdot 2858 = \log 1\cdot 932$
$\therefore \sqrt[3]{7\cdot 204} = \mathbf{1\cdot 932.}$

13. Compound Interest and Annuities.

I. To find the amount of a given sum at compound interest in a given number of years at a given rate per cent. per annum.

Let P denote the principal, n the number of years, and $100r$ the rate per cent. per annum.

The interest on P for 1 year $= Pr$.
$\therefore$ amount at end of 1st year $= P + Pr = P(1 + r)$.
The interest on $P(1 + r)$ for 1 year $= P(1 + r)r$
$\therefore$ amount at end of 2nd year $= P(1 + r)$
$+ P(1 + r)r = P(1 + r)^2$
Similarly, amount at end of 3rd year $= P(1 + r)^3$
and A_2 at end of nth year $= P(1 + r)^n$
$\therefore \log A = \log P(1 + r)^n = \log P + n \log (1 + r)$.

If the interest is payable half yearly

$$A = P\left(1 + \frac{r}{2}\right)^{2n}$$

Example:—

Find the amount to the nearest pound of £350 in 25 years, interest at 5% being paid half yearly.

Here $P = 350$, $r = \frac{5}{100} = \cdot 05$, $n = 25$
$\therefore A = 350(1\cdot 05)^{25}$ $\therefore \log A = \log 350$
$+ 25 \log 1\cdot 05$
$\log 350 = 2\cdot 5441$ $\log 1\cdot 05 = \cdot 0212$
$25 \log 1\cdot 05 = \cdot 5300$
$\overline{3\cdot 0741} = \log 1186$
$\therefore$ Amount = **£1186.**

II. To find the Present value of a sum of money which is to be paid at the end of a given time.

Let A denote the sum payable at the end of n years, let P be its present worth, the interest on money being $100r$ per cent. per annum.

Then $P = A(1 + r)^{-n} = \frac{A}{(1 + r)^n}$
$\therefore \log P = \log A - n \log (1 + r)$.

III. To find the Present value of an annuity of £A payable at the end of each of n successive years.

Let the interest on money be $100r$ per cent. per annum.

The present value of the 1st payment $= A(1 + r)^{-1}$
The present value of the 2nd payment $= A(1 + r)^{-2}$
The present value of the nth payment $= A(1 + r)^{-n}$
Then the Present value of the whole

$$= A\left\{\frac{1}{1 + r} + \frac{1}{(1 + r)^2} + \frac{1}{(1 + r)^3} \cdots + \frac{1}{(1 + r)^n}\right\}$$
$$= \frac{A}{r}\left\{1 - \frac{1}{(1 + r)^n}\right\}$$

Example:—

What is the present value of an annuity of £100 a year to be paid for 40 years, interest being reckoned at 4% per annum?

$A = 100$, $n = 40$, $r = \frac{4}{100} = \frac{1}{25}$

hence the present value $= 100 \times 25\left\{1 - \left(\frac{25}{26}\right)^{40}\right\}$

Now $\log \left(\frac{25}{26}\right)^{40} = 40\{\log 25 - \log 26\}$
$= 40\{1\cdot 3979 - 1\cdot 4150\}$
$= 40(\bar{1}\cdot 9829) = \bar{1}\cdot 316$
$= \log \cdot 207$
$\therefore$ present value $= 100 \times 25(1 - \cdot 207) = 25 \times 79\cdot 3$
$= 1982\cdot 5$
i.e. present value = **£1982 10s.**

Exercise 5

Find the value of the following to 4 significant figures:—

(1) $175\cdot 6 \times \cdot 2632$. (2) $7\cdot 302 \times \cdot 7302 \times \cdot 007302$. (3) $35\cdot 86 \times 2\cdot 105 \times \cdot 8372 \times \cdot 00294$.

Divide—

(4) 30·56 by 4·105. (5) 241·6 by 4·567. (6) ·01254 by ·4105.

Find the value of the following—

(7) $\frac{15\cdot 38 \times \cdot 0137}{276 \times \cdot 0038}$. (8) $(9\cdot 163)^4$. (9) $(1\cdot 73)^{11}$

(10) $\sqrt{\frac{25.}{3}}$ (11) $\sqrt[4]{\cdot 00765}$. (12) $\sqrt{\frac{\cdot 678 \times 9\cdot 01.}{\cdot 0234}}$

(13) Find to the nearest pound the amount of £35 in 25 years at 3% compound interest.

(14) Find the amount to the nearest pound of £500 in 10 years, interest at 4% being paid half-yearly.

Key to Exercise 2

(1) ·0000, 0·8451, 1·8513, 1·9912, 0·6021.
(2) $\bar{1}\cdot 0000$, $\bar{1}\cdot 8451$, $\bar{2}\cdot 8513$, 0·9912, $\bar{3}\cdot 6021$.
(3) 2·4200 1·6946, $\bar{3}\cdot 6243$, 5·7604, 0·4900.

Key to Exercise 3

(1) 3·1953, 1·3166, 4, 0·7166.
(2) 3·0004, 3·3711, 0·8453, 0·1156, $\bar{3}\cdot 8083$.

Key to Exercise 4

(1) 6·101, 100·1, ·9977. (2) 40270, ·001457, 11·77.

Key to Exercise 5

(1) 46·22. (2) ·03892. (3) ·1858. (4) 7·446. (5) 52·91. (6) ·03055. (7) ·2016. (8) 7049. (9) 182·7. (10) 2·887. (11) ·2958. (12) 16. (13) £73. (14) £743.

M. A. L.

Continued from page 174.

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

WATER-COLOUR DRAWING—VI

IT is necessary to keep before you the fact, that it is not only landscape that you should observe with a view to water-colour drawing. Still life in all its manifestations gives you valuable experience when closely watched for variation in colour and tone.

Interpretation of Colour

Now study the objects shown opposite, or do better still and procure the objects themselves and pose them on a table as they are in the illustration—a jam jar, a lantern, and a bottle. Let them have the light coming from the left. It is waste of time to detail a scheme of colour here without, at all events, pointing out that the objects may be of every conceivable tint. But the important point is to know *how* to observe the colours and forms of objects.

The individual interpretation of such colours and forms may be left to the student, who will by now have learnt how to observe, and how to put his own individuality into any given subject. Indeed, nothing is more instructive or interesting than to observe how two different artists will interpret the same object.

The objects as seen by A will be quite different to those very same objects as seen by B. The very forms will have a subtle distinction, whilst the colours will be widely divided. Of course, there is much more scope for individual observation in colour than in form. But each, nevertheless, gives room for the personal view.

Once you have learnt the rudiments of the art, the rules that are universal, you should do your best to develop yourself and to put your own feelings upon paper or canvas, to express your own outlook. Art should be self-expression, bounded very rigidly by golden rules. But the fundamental rules of drawing, of colour, and of perspective are always golden and must not be broken.

Take the example given and follow out the general principles in rendering it. Begin with the jam pot on the left. The chances are strongly in favour of your obtaining a jar which is of a warm brown tint from the top to just below the shoulder. Some are definitely lighter. In the former tint, burnt sienna is strongly in evidence. But the colour will probably be rather uneven. This being the case, lay on your burnt sienna, and whilst it is wet put in some madder brown to correct the vividness of the burnt sienna, and add a little sepia for the darker parts.

Beneath, the colour is something like that of a pale biscuit. For this, make a grey tint of cobalt blue, a touch of lake, and some sepia. Add to this grey some raw umber and yellow ochre. There should be more yellow ochre than anything else. The grey should take the smallest part in the mixture.

Dangers of Exaggeration

Sometimes it happens that there is a reddish tinge at the bottom of the pot. This will best be rendered by drawing a very little crimson lake over the yellowish ground as soon as it is dry. This tint is exceedingly faint, and great care should be taken not to exaggerate it. Use for it a very weak solution indeed.

This slight crimson tint is an example of what frequently has to be rendered by the artist, but it is so subtle and obscure that it is exceedingly difficult to see it at all in the first place (unless, as in this case, you are told it is there), and secondly, it is extremely hard to render well without exaggerating the strength of the tone. Remember here a definite rule about laying one colour as a glaze over another. The first, bear in mind, must be quite dry. Pass the brush over every part that requires it *once*. Even that will soften the underlying tint. If the brush passes over again, the lower tint will be rubbed up and the effect will be dirty and spoiled.

Another thing to remember in this kind of work, when the exact colour is hard to determine upon, is to practise the colour upon a spare sheet of paper and then to hold it at a distance next to the object you are trying to reproduce on the

STUDIES IN STILL LIFE

are strongly recommended to the student. Three objects such as the above may be selected and should be studied carefully with reference to the accompanying lesson which explains in detail the colour guide shown at the top of the page.

picture. This will frequently save you time in the end and save unnecessary blunders.

Another point of which you must never lose sight is the careful distinction between warm colours and cool ones. Go over an object with your eye before beginning to paint it and satisfy yourself where the warm colours are placed and where the cool. The relative positions of these are exceedingly important. You must watch carefully where they blend or how they are divided from each other, perhaps, by a brilliant patch of high light.

But in no case on a similar surface must you expect the difference to be very evident. Such differences are usually so subtle as to be almost imperceptible.

Light and Shade

Notice in the jam pot you have before you there is a warm tint, marked in the rough sketch *b b*, which should be composed of burnt sienna and raw umber. The edges of this are broken off towards the light. This has to be done very carefully *over* the first layer of colour. On the side where the shadow is, this warm tint merges into grey. This grey is distinctly cool at the edge of *the* pot. Here is an instance of warm colour breaking into cool. Now you have to put on the broad and cast shadows. Remember the receipt for a good and generally useful shadow tint which may well be applied in this case—cobalt, crimson lake and sepia. Between *b b* and *c c*, you will find the darkest part on the object, at *c c* it is quite sharp and firm.

Wash the edge off towards the light, but continue it to the side of the jar on the other or shadow-side with a cool grey. The broad shadow should be of a lighter tone than the cast shadow. *d d* are brilliant shining high lights. These should be wetted after the rest is dry and very carefully rubbed off with a piece of india-rubber. This will give an absolutely white surface, which is what you need.

It is possible that the jar before you may have a purer yellow on the inside than on the outside. Be careful then to differentiate, if necessary, in the small part of the inside which is visible. Burnt umber will be the best colour to use.

Remember, then, when you do the rim, which is distinctly brown, the line should be clear and sharp. Having gone thus far, pause and look very carefully over the pot with half-closed eyes. It is highly likely that you will now observe touches of colour here and there which you had not noticed before in the general effect; notably, you may see the necessity for the introduction of a little crimson lake. This will be especially to be observed on the light side. Also a little glazing of raw sienna may be found necessary.

This will be where the brown is not so dark and deep. It is quite likely, also, that just a suspicion of indigo may be observed here and there. This will need to be washed over very sparingly. It is, however, only possible to give general indications of what *may* be seen. Jars of this sort vary considerably. But by mentioning details of this kind in one particular case, it may help the reader to see details of a possibly quite different kind in other cases.

The lantern comes next. This, we will take it, is made of tin and is of a very usual sort. The prevailing colour is grey. It is possibly *rusty* Rust is well rendered by the judicious use of Indian red. The general effect of greyness will be broken here and there by warmer or cooler colours, as the case may be. The extremely sharp, dark shadows beneath the rim and in corners here and there, can be well done with sepia and indigo, to which is added a touch of crimson lake. Sepia and indigo alone give a beautiful colour, but it is prone towards greenness. The crimson lake will nullify this effect and give intensity to the colour.

It is now time to turn to the background. This will throw up the three objects in relief and give you some idea of the strength or otherwise of the colours in them. Very likely this background, when done, will show you some lack of definite colour in parts of the objects.

First wash in the background with grey to a line just below the top of the jam jar. Then carry it on from there to the bottom of the picture with the addition of some raw umber and some yellow-ochre.

A good plan will be to follow up this when it is dry by washing terre-verte over the grey part of the background only. This will give a slightly green effect, which stands in good contrast to the reddish part of the lower background and throws up the lantern particularly well.

Last of all do the bottle.

What Colour is Cork?

You should bear in mind that this bottle is dark: so much is certain in almost any case. But be sure to procure an ordinary wine bottle. It will thus stand out in considerable contrast with the other objects. The colour chiefly to be employed in this bottle will be sepia with indigo—a fine rich tint. But you will see this colour broken up here and there by other tints which will largely depend upon surrounding objects.

Notice, for example, where the reflection of the jar causes the narrow strips of middle tone, marked *a a*. A glass bottle is controlled, so far as its colour goes, by every object near it, owing to reflection. Notice your cork. Raw umber with a touch of yellow ochre gives the required tint. Put the shadow in sepia. The darkest parts, where there are no reflections, may be given by very deep indigo with sepia. Here and there come very cool tones which will be done with a wash of indigo alone.

When finally you come to the very darkest parts of all, you may use a little gum. This intensifies the darkness; only it should be carefully and sparingly used.

Such are the general rules, then, that may be laid down on the subject of water-colour drawing. The instances are given, you should remember, only to illustrate principles which pervade the whole art from A to Z. J. G. B. L.

Continued from page 186.

ENGLISH LANGUAGE AND LITERATURE:

Contributors:—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY (E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

NINETEENTH CENTURY PROSE

THE prose of the nineteenth century expands into so many departments—history, essays, criticism, theology, science, nature observation, and biography—that only the most summary mention can be made of the chief writers in each division.

Historians

History on a broad European scale was attempted by Sir Archibald Alison (1792–1867) in his *History of Europe*, the period covered being from the beginning of the French Revolution. Alison was a painstaking sheriff in Scotland, and a writer on Scottish law, and nothing shows so clearly the accumulated neglect of history as the early popularity of his ponderous, prosy, and one-sided work.

Sir William F. P. Napier (1785–1860) was the very opposite of Alison in opinion and literary style. His brilliant *History of the War in the Peninsula* is a classic in so far as it deals with the fighting under Moore and Wellington, under whom the author served with distinction.

Henry Hallam (1777–1859), a lawyer, who became a civil servant, wrote history with the mind of a judge, cool, clear, and dispassionate. In his *View of the State of Europe During the Middle Ages* (1818), and his *Constitutional History of England from the Accession of Henry VII. to the Death of George II.* (1827); he displayed wide reading and a strong desire for impartiality; but Hallam's literary taste had an insufficient breadth for such a cosmopolitan task as his *Introduction to the Literature of Europe in the Fifteenth, Sixteenth, and Seventeenth Centuries* (4 vols., 1837–39).

George Grote (1794–1871) retired from successful banking in his fiftieth year to finish his great *History of Greece*, published in 12 volumes (1846–1856). Though much new light has been thrown on Greek history in recent years, Grote's minute research and breadth of judgment, presented in vigorous prose, give his work a lasting value.

Thomas Babington (Lord) Macaulay (1800–1859), was not known to his countrymen till the publication of his *Life and Letters* in 1876, by his nephew, Sir George Trevelyan. Then it was seen that the idea of hard, glittering brilliance, derived from the picturesque but somewhat strident energy of his writing and talking styles, was only representative of him when he either had a pen in his fingers, or rose to convince the House of Commons. At home he was one of the most delightful and lovable of men.

After leaving Cambridge Macaulay felt he must add to the resources of his family, and besides holding a legal appointment, he began to contribute to the Reviews. Whatever he did proved instantly successful.

Macaulay's *History of England*

His first article in *The Edinburgh Review* (on Milton) made him famous. His first speech in the House of Commons, before he was thirty, captured the legislature; and he swiftly gained office. In four years from his entry into public life he was on his way to India as a member of its Supreme Council, and in four years there he codified the criminal law of the country—a monumental work—and incidentally saved a competence.

Returning, he renewed his Parliamentary success, and became a Secretary of State. Meantime, he was writing his swift and stirring *Lays*, producing historical and literary essays—and planning his *History of England*. The first two volumes were published in 1848, and the third and fourth in 1855. It was the greatest book-success on

record. Macaulay was raised to the peerage two years before his death. His *History* embraces the reigns of James II. and William III. It is, however, through his essays that he is now best known. They never lose their charm for young students of history.

Thomas Carlyle (1795–1881), though the picturer of the French Revolutionary conflagration, the biographer of Frederick the Great, and the collector of the letters, and clearer of the character of Cromwell, will probably be read longest as an essayist in his *Sartor Resartus*, *Heroes and Hero Worship*, and *Past and Present*. Carlyle's admiration for the effects of might has been so discounted by the doings of the Prussians he flattered, that he is out of harmony with the modern spirit; but his influence on his generation, sunk in a sordid materialism, was vivifying. His style in writing, entirely his own, is least capable of imitation of any prose style ever invented. In flashes, a seer and poet, Carlyle is perhaps most impressive as a sorrowful humorist, with an inconclusive philosophy.

The American historians, George Bancroft (1800–1891), who wrote with sturdy purpose the earlier story of his country; William Hickling Prescott (1796–1859), who sketched with dramatic power, after careful research, periods of Spanish history, and the conquests of Mexico and Peru; John Lothrop Motley (1814–1877), the picturesque chronicler of the most stirring periods in the history of the Netherlands; and Francis Parkman (1823–1893), the industrious and increasingly successful recorder of the struggle between the French and English races in North America before the period of American independence, give unitedly to the American section of the English-speaking people a distinguished share in historical inquiry, and its expression in glowing narrative.

James Anthony Froude

James Anthony Froude (1818–1894) published, between 1856 and 1870, in twelve volumes, a *History of England from the Fall of Cardinal Wolsey to the Spanish Armada*, which is literature rather than history. Its hero is Henry VIII. Froude regarded history as the drama of the centuries, and wrote as a narrative dramatist, with a style beautiful in its lucidity and simplicity. As for facts, well, history was to him a child's box of letters with which any word may be spelled. He spelled from the box with picturesque inaccuracy to suit his strong opinions. The result is charming reading but quite uncertain history.

Froude edited Carlyle's *Reminiscences* with cruel indiscretion, wrote Carlyle's life, and prepared Mrs. Carlyle's *Memorials*.

Edward Augustus Freeman (1823–1892), who preceded Froude as Professor of Modern History at Oxford, was the direct opposite of Froude. He worshipped precision in research and hated literary display. His *History of the Norman Conquest*, in six volumes, is a monument of exact inquiry, written with a too rigid love of early-English English. Freeman helped to found the History School at Oxford, which has done work of high value through such historians as Stubbs, Gardiner, C. H. Firth, Oman, and Herbert Fisher.

Henry Hart Milman (1791–1868), Dean of St. Paul's, who first wrote verse and then history, introduced in his *History of the Jews* (1829), now superseded, the treatment of the Biblical record as history. His *History of Latin Christianity* (six volumes), since supplemented considerably by modern research, is a work of substantial value. Milman also edited Gibbon.

Henry Thomas Buckle

Henry Thomas Buckle (1821 – 1862), planned a *History of Civilization in England* on scientific principles, but died shortly after the publication of the second volume of the fourteen projected. Buckle argued that civilisation advances by discoverable sequences depending on the expansion of knowledge, and he attempted to trace the sequences in the form of natural laws. Though his generalisations have not been widely accepted, his suggestions had a stimulating effect.

William Stubbs (1825–1901), who died Bishop of Oxford, was a most industrious worker on the facts of history, and his *Constitutional History of England*, dealing with a period before that covered by Hallam, is a standard work, in heavy style.

Samuel Rawson Gardiner (1829–1902), a great historian, methodical, accurate, impartial, specialised on the period James I., Charles I., and the Commonwealth, in a series of volumes that occupied over forty years in writing. Gardiner also published more than one condensed history of England. He avoided fine writing with as great care as he avoided error.

Alexander William Kinglake (1809–1891), a successful barrister, scored a brilliant success with his travel-book *Eōthen*, an account of a tour in the East. It is one of the books that must not be missed. Later he wrote the official history of the Crimean War, in

eight volumes, which proved "too much of a good thing." Kinglake's style has brightness with dignity, but he lacked the power of selection.

Sir John Robert Seeley (1834–1895), Professor of Modern History at Cambridge, published anonymously, in 1865, *Ecce Homo*; a review of Christ's work as inspiring what

From the portrait by Sir Francis Grant, P.R.A., in the National Portrait Gallery.

THOMAS BABINGTON (LORD) MACAULAY (1800–59), whose *Essays* never lose their charm for young students of history.

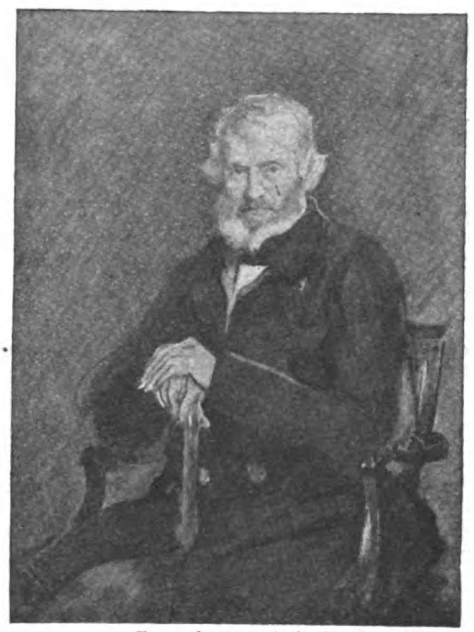
the author called "the enthusiasm of humanity." The charm of Seeley's style added greatly to the popularity of the book. His most ambitious work was his *Life and Times of Stein*, the Prussian statesman, who tried in vain to democratise Prussia. His *Expansion of England* (1883), perhaps more than any other single influence, helped the British people all over the world to realise their essential unity.

William Edward Hartpole Lecky (1838–1903), a charming Irish gentleman, wrote three historical books very broad in their survey—*History of the Rise and Influence of the Spirit of Rationalism in Europe* (1865), *History of European Morals from Augustus to Charlemagne* (1869), and *History of England in the Eighteenth Century* (twelve volumes). Lecky recommends his freshly thoughtful conclusions by a lucid and gracefully animated style.

John Richard Green (1837–1883), the most popular of later historians, published in 1874 his *Short History of the English People*, with instant success. It was a short history, because ill-health was already pursuing him. He lived nine years longer, expanding his one volume into four, and then recommencing on a still wider scale with *The Making of England* and *The Conquest of England*.

It was the life of the people, not foreign wars, or the adventures of kings, or the pomp of courts that appealed to him. While he was a student of detail, after the manner of Stubbs, Green had, in a high degree, imagination, sympathy, and the power of marshalling the knowledge he had acquired.

James (Viscount) Bryce (born 1838), Professor of Civil Law at Oxford, politician, and



From the portrait by Sir John Millais, P.R.A., in the National Portrait Gallery.

THOMAS CARLYLE (1795–1881), whose writings, though out of harmony with the spirit of to-day, had a vivifying effect on an age sunk in sordid materialism.

ambassador, had already entered Parliament when (1884) he published *The Holy Roman Empire*. Four years later appeared his great work on the constitution of the United States, *The American Commonwealth*.

With the growth of popular periodical literature, and newspapers that embraced all human interests in their survey, the number of essayists, publicists, critics, and miscellaneous writers increased continuously through the nineteenth century, and included many who added to the permanent literature of the nation. Only a few of the most con-

spicuous can be named here, excluding those whose writing, though once influential, has now lost its interest. William Godwin and Francis Jeffrey, already mentioned, are instances, in different literary spheres, of such complete supersession.

Charles Lamb (1775–1834), a Christ's Hospital scholar, and then a clerk at "the desk's dead wood" in the India House till his fiftieth year, a poet and friend of poets, is perhaps the best-known man in our literature, and quite the most beloved. He joins the friendly circle in nearly all the literary memoirs of his generation; but it is through the self-revelation in his unique *Essays of Elia* that we know him most truly.

Lamb and the Essayists

No man ever put his *self* into his writings more completely. His reader is a friend to whom he confides his tender fancies, whimsical humours, penetrating glimpses of life's pathos and heroisms, in a language saturated with the literary spirit and idiom of the later Shakespearean age. His domestic life, with his frequently-demented sister, Mary, was one of quiet and patient heroism.

William Hazlitt (1778–1830), first a portrait painter, and then a critic, belonged to the circle of Coleridge and Lamb. Cross-grained and dogmatic, he must have been an awkward man to know, but he wrote about any enjoyment, literary or personal, and especially about outdoor life and observation of men, with a zest, insight, and force that will long preserve his essays.

Thomas de Quincey (1785–1859) retains popularity alongside Hazlitt, but far in the rear of Charles Lamb. He is essentially an artificial writer, but his elaboration reaches the rank of art, and is highly interesting, even when it misses the note of sincerity. He consciously "composed" his most characteristic passages. His *Confessions of an English Opium Eater* contain the best examples of his simpler narrative style, and also of his "purple patches." His writing illustrates some extreme possibilities of English prose. He was an eccentric, living an elusive, furtive life, and is never to be trusted as a guide.

Leigh Hunt (1784–1859), a miscellaneous writer—essays, criticisms, and verse—who linked the circle of Wordsworth, Lamb, and Keats with Byron, had a useful influence in extending the study of literature, but his own writing lacks depth, and sometimes taste, and he is now only read as a descriptive essayist. In that capacity he helped to form the early style of Dickens.

William Cobbett (1762–1835) was an instance of a writer who appeals to the plain reader and interests equally the student of literature. He was a self-educated soldier, who became a politician, and boxed the whole compass of public partisanship. He had no scruples on points of taste, but in a dogmatic manner, hurled himself on any objector.

His bold, clear, confident style may be sampled in his *Advice to Young Men*—a manual of life—and his *Rural Rides*.

George Borrow (1803–1881) wrote desultory books of travel, largely concerned with the people met and conversed with by the way. Sometimes these wanderings take the form of gypsy stories. *The Bible in Spain* and *Wild Wales* have the more direct travel form; *Lavengro* and *Romany Rye* the cast of fiction; but in all his books George Borrow and his outlook on men and nature are the real centres of interest.

Walter Bagehot (1826–1877), a west-country banker, who became editor of *The Economist*, and wrote the best short book on *The English Constitution*, and on City finance—*Lombard Street*—was also a literary critic, with a delightful freshness of thought and expression.

Morley's Biographies

John (Viscount) Morley, born in 1838, continued an influential career as a journalist by winning high distinction as a statesman. As an historical essayist on eighteenth century French leaders of thought, a literary critic, and a biographer, Morley is unsurpassed in the union of weighty reflection and grace in diction. His monographs on Burke and Walpole were followed by lives of Cromwell, Cobden, and Gladstone, and a wholly charming reminiscent autobiography.

Frederic Harrison (born 1831) wrote continuously through a long life. His most compact and finished books being admirable compendious monographs on Cromwell and Ruskin.

Among American prose-authors mention must be made of Ralph Waldo Emerson (1803–1882), whose writings, apart from a small output of rugged but genuine poetry, were all reprinted lectures. Though he was strangely deficient in constructive form, Emerson was the most weighty and stimulating writer that America has produced.

Washington Irving (1783–1859) was the first travelled American man of letters. His ornate romanticism helped to interpret England to his countrymen. His *Sketch Book* is his best-known work. In writing history he was less successful.

From the picture by F. S. Cary in the National Portrait Gallery.

CHARLES AND MARY LAMB.

The author of the *Essays of Elia* is perhaps the best-known man in our literature, and the most beloved. His domestic life with his frequently-demented sister, Mary, was one of quiet and patient heroism.

Oliver Wendell Holmes (1809–1894) discovered a new method of discursive comment, comparable with clever conversation, in his breakfast-table series—talks in an American boarding-house. His *Autocrat, Professor*, and *Poet*, following in that order, declined from ease in the direction of literary formality.

Two English nineteenth century prose-writers who will long attract readers by their style, irrespective of their topics, were John Henry Newman and John Ruskin.

John Henry Newman (1801–1890) seceded from the Anglican Church, and eventually became a Cardinal. Much of his influence radiated from a character of great charm and purity, but his writing had analogous qualities. In his style, simplicity and clarity were refined into beauty. He wrote a story, *Callista*, and a poem, *The Dream of Gerontius*, but his most widely read books are his defence of his change of religious faith, *Apologia pro Vita Sua* and *A Grammar of Assent*.

John Ruskin

John Ruskin (1819–1900) defies classification as a writer. He began as an interpreter and critic, first of painting and then of architecture, in *Modern Painters*, *The Seven Lamps of Architecture*, and *The Stones of Venice*. Then he digressed into economics and morals, criticism, and autobiography. His typical books on economics are *Unto this Last* and *Munera Pulveris*; his most popular social disquisitions *Sesame and Lilies* and *The Crown of Wild Olives*.

In the second half of the nineteenth century the serious appreciative literary criticism that had been developed by such writers as Coleridge, Hazlitt, and Charles Lamb may be said to have become a branch of literature. This growth had been made necessary by the popularising of education and reading. The partisan violence of the earlier political reviews, such as the *Edinburgh* and *Quarterly*, was discredited and discarded, and authorship was judged strictly on its literary merits. That great work of reference the *Encyclopædia Britannica*, and, later, the invaluable *Dictionary of National Biography*, with the more succinct *Chambers's Cyclopædia of English Literature*, reached a high standard of impartiality. Series of critical studies also appeared in book form, the most comprehensive being the *English Men of Letters*, edited by John Morley.

In this department of criticism mention must be made of Sir Leslie Stephen (1832–1904), the first editor of the *Dictionary of National Biography*, and his successor, Sir Sidney Lee; of Dr. Edward Dowden (1843–1913), who did much towards systematising the study of Shakespeare; of Stopford A. Brooke (1832–1916), a critic of poetic temperament, who made a careful study of Anglo-Saxon literature, and wrote a brilliant sketch of the general course of English authorship, besides a number of estimates of poets; of Dr. George Saintsbury, who covered both prose and poetry in many works; of W. J. Courthope (born 1842), who completed a history of English poetry; of Dr. Edmund Gosse, who combined broad views as a critic with poetic grace in diction; and of Dr. Andrew Lang (1844–1912) and the Right Hon. Augustine Birrell, who popularised the literary causerie with humour and lightness of touch. Nor should the House of Cassell omit a reference to the long and varied critical labours of Professor Henry Morley (1822–1894), who first placed the English classics within reach of the poorest reader by his editorship of the *National Library*.

In the nineteenth century science, usually represented only in books of solid information, arose through the skill of a few writers to the level of literature, as in the writings of John Stuart Mill (1806–1873), a master of clear, if cold, argument; Charles Darwin (1809–1882), who could support broad principles by copious illustrations without dullness; and Herbert Spencer (1820–1903), the most widely known English writer on the Continent after Shakespeare and Byron.

Popular Science

Popular science was most picturesquely represented by John Tyndall (1820–1893), a skilful stylist with the gift of marshalling and illuminating his facts; Thomas Henry Huxley (1825–1895), a brilliant if too pungent controversialist; and Sir Robert Ball (1840–1913), who could mingle humour with scientific disquisition.

Some of these critics and men of science, as for instance Sir Leslie Stephen, in his *Playground of Europe*, and Professor Tyndall, in his *Scrambles amongst the Alps*, added to the classics of travel.

In bringing this rapid survey of English literature to within touch of the present day, admission must be made that now, while successors of the great poets are but few, though versification has lost none of its attractions, the writers of strong, clear, animated English prose were never before so numerous, and the general style in best repute has seldom been less marred by affectation or over-strain. J. D.

PUBLIC SPEAKING

To speak well in public is an art and an accomplishment which adds considerably to the popularity of any man.

Eloquence is a natural gift, but no man need despair of becoming a proficient and even an eloquent speaker if he will give the subject careful study.

So great has been the demand that Public speaking has almost reached the dignity of a profession.

At one time it was the practice to rely on literature as the medium for informing the electorate on the pros and cons of any great issue which stood before the country. With the extension of the franchise, however, it was felt that something more was required to stimulate interest, and the spoken word has been found to be more effective.

What do we constantly hear in everyday life ? The business man says : " I must see Mr. So-and-So. Half an hour's interview will be worth a score of letters." So it is with the politician ; he says : " Let us have a few meetings ; they will help us to arouse the public interest."

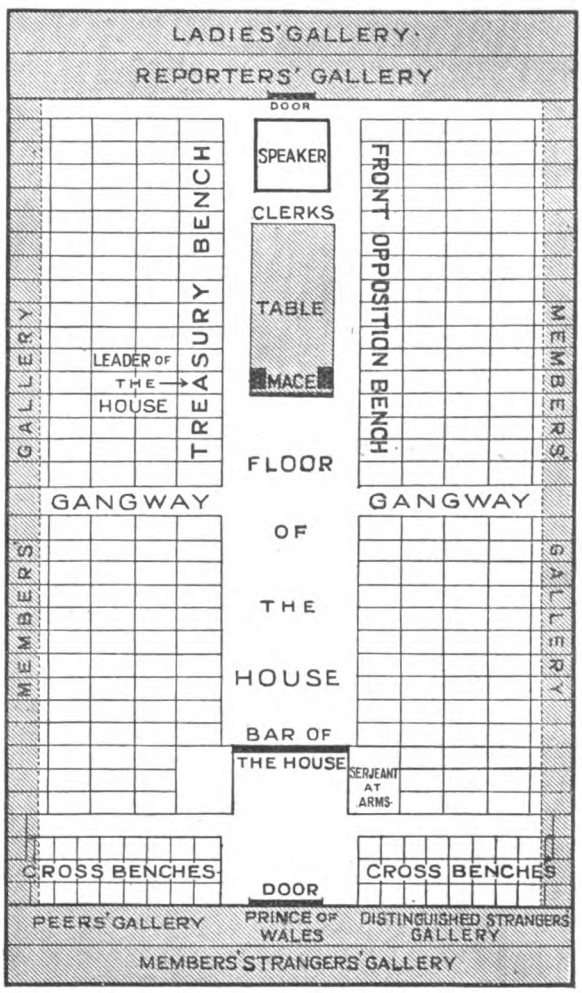
The Spoken Word

We do not wish to disparage literature, but the spoken word, with the tone of voice, the flash of the eye, the sweep of the arm, the eloquent pause, are the subtle channels through which the speaker can appeal to the emotions of his audience. The speaker by his personality compels attention in a subject, and the written word is then sought after with greater avidity.

Some of the political organisations which employ speakers are : The National Unionist Association of Conservative and Liberal Unionist Organisations, St. Stephen's Chambers, Westminster ; The National Liberal Federation, Parliament Street, Westminster ; The Free Trade Union, 75 Victoria Street ; The Cobden Club ; The Tariff Reform League ; The Primrose League ; The Land Union ; The Rural Labourers' League ; The Independent Labour Party ; Socialist organisations such as The Christian Socialists ; The British Socialist Party ; The Socialist Party of Great Britain, the Fabian Society, and The Labour Party, 33 *Eccleston Square, S.W.*1.

The Anti-Socialist Union of Great Britain, The London Municipal Society and the Anti-Socialist Union of the Churches are organisations formed to oppose socialism.

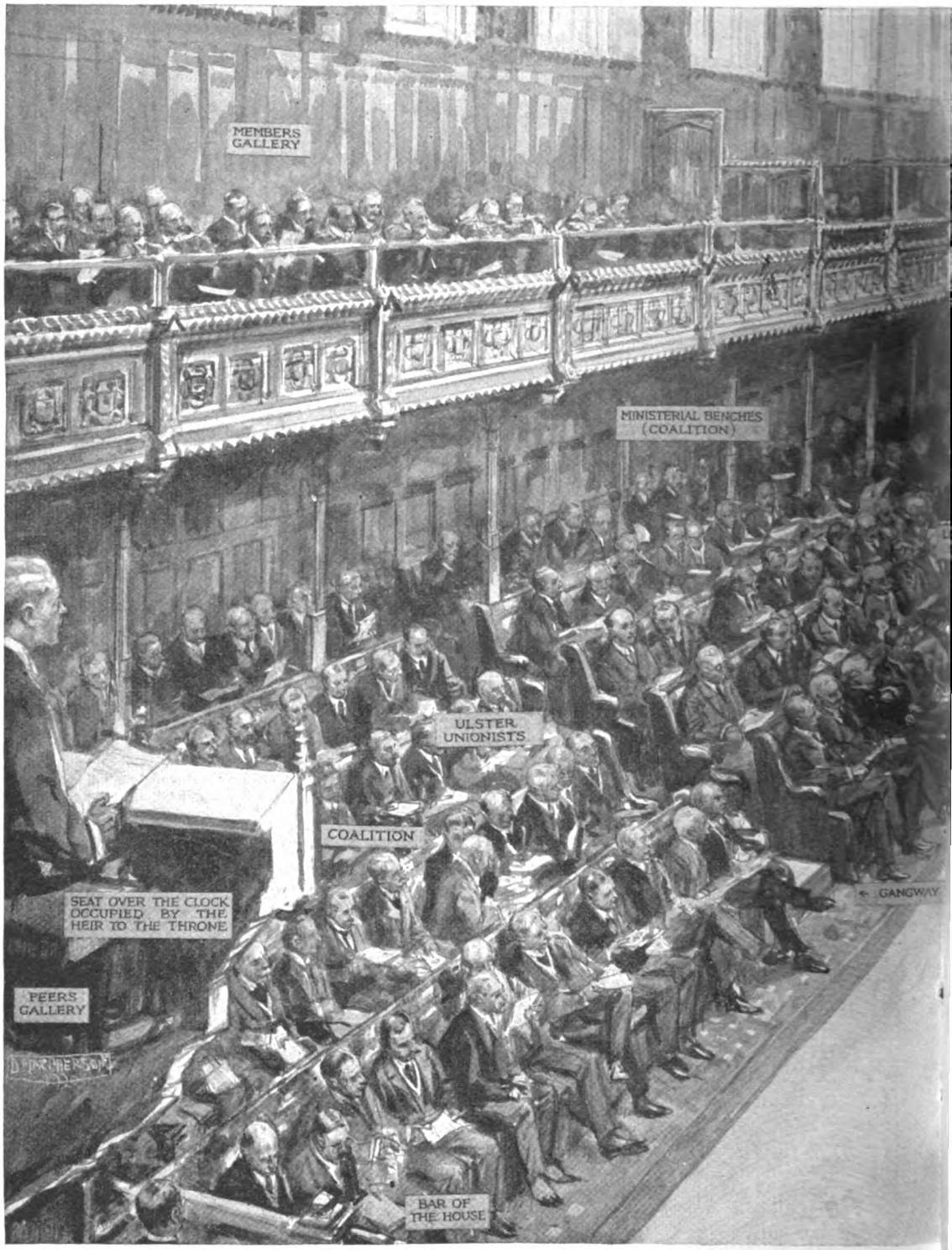
In addition to these organisations there are various Temperance Organisations, Social Reform Organisations, The National Trade Defence Association, The Licensed Victuallers' Association, The Navy League, The Imperial Maritime League and The National Service League, all of which employ speakers on the various subjects they advocate.



THE HOUSE OF COMMONS.
A plan of the interior, including the various galleries.

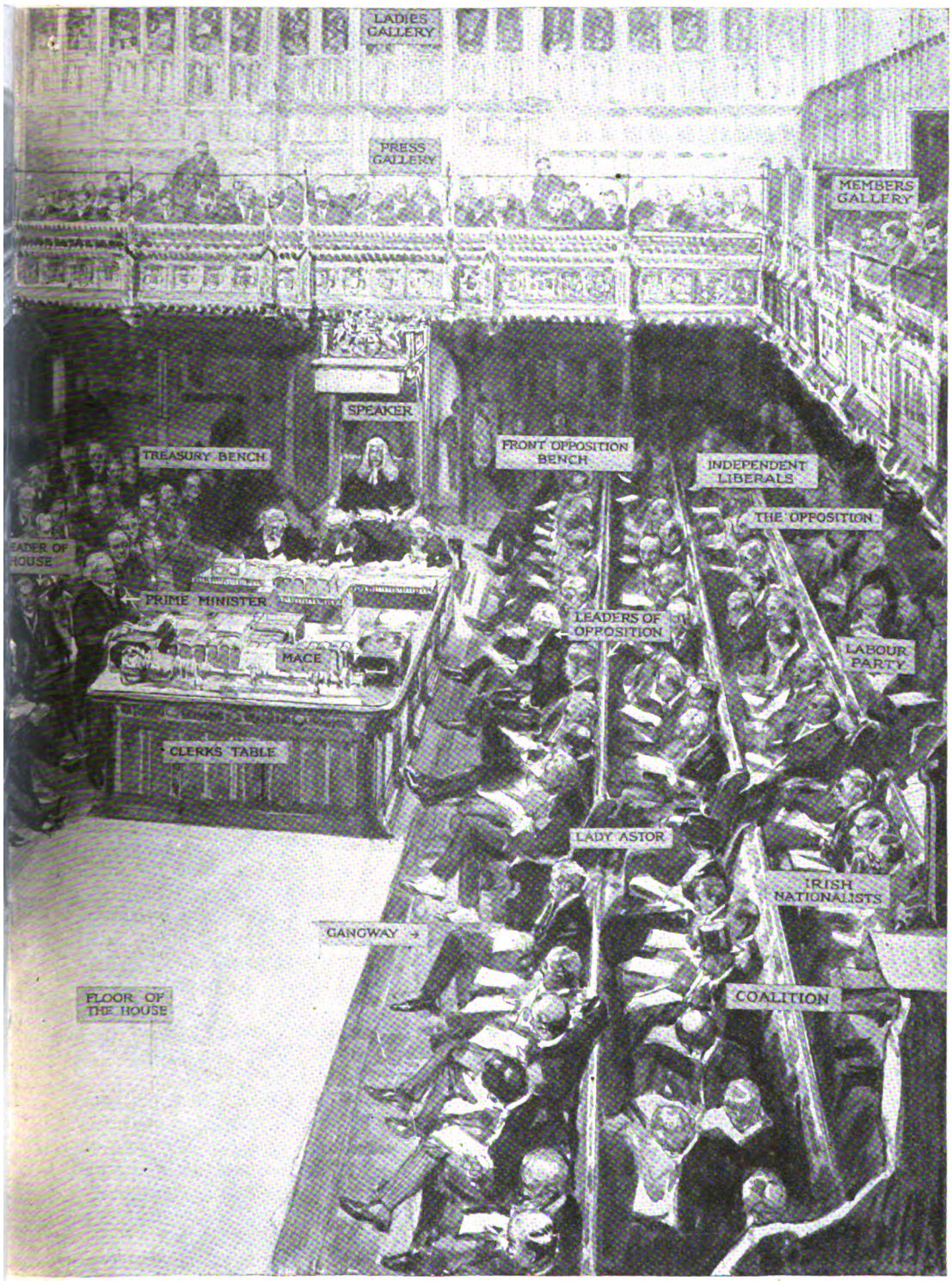
Some of the political organisations hold classes for training speakers, and keep up a regular staff in addition to a large auxiliary staff, which finds employment during election times.

It is often said that the power of speech is a gift and cannot be acquired. There is no greater mistake. One has only to read the lives of our greatest statesmen to realise this.



THE "COALITION"

Having crowned the nation's efforts during the Great War with victory, the Coalition Government drawing represents a "full dress" debate in the House during this anxious period, immediately after the Astor, the first woman Member of Parliament, is seen in the seat below



Drawn by D. Macpherson.

HOUSE OF COMMONS.

found itself called upon to grapple with the even more difficult problems of reconstruction. The above return of Mr. Asquith, who is seen on the Front Opposition bench facing Mr. Lloyd George. Lady the gangway which she occupied at the beginning of her Parliamentary career.

Grace of diction, ease of manner, and fluency of language, are in nearly all cases the result of hours of study.

When one listens to a speaker who talks fluently, with apparent ease and with few notes, for an hour or more, one is apt to exclaim : " He is a born orator."

It is true that there are men who can string together a number of sentences which please the ear, but a speech of this kind will neither carry conviction nor bear examination.

Talleyrand once said : " Words were given to us whereby to conceal our thoughts."

The same may be said of the unprepared speaker; he has fascinated his audience, but he has concealed his thoughts, if he ever had any.

A Good Beginning

The first essential then for the would-be speaker is to make up his mind to work: it is the only road which leads to success. He must master his subject.

He need not necessarily, even if he could, read all that has been published on the subject, but he should select the best authority and, if it be a controversial subject, make himself acquainted with both sides.

To expose a fallacy is often as important and effective as to state a fact.

Having selected a subject and mastered the details, the next thing to consider is how to arrange the knowledge acquired for delivery.

This must be done on a system. From the knowledge you have acquired by reading you will have arrived at a conclusion in your own mind what are the strongest points. Arrange these in their order to prove that the conclusions you wish your audience to arrive at are established step by step.

Do not begin with your strongest argument, but first state in clear language what you intend to prove, and proceed to build up the subject, to arrive at a climax, or, in other words, drive your arguments in much the same way as you would a nail.

Commence with slight taps until you get the point in, and then by harder blows until it is driven right home.

Your audience will follow you and appreciate what you say. If you begin with your heavy blows you will weaken afterwards, and by the time you reach the end of your speech the strongest argument will have been forgotten and the audience will go away, your supporters disappointed with the case you have presented, and your opponents relating your final arguments as the best that you could say.

The preparation of a speech will entail a great deal of writing and rewriting.

The subject should be divided into compartments or heads. The old-fashioned sermon known as a " three decker " has its advantages, and the principle can be followed in preparing a speech with success.

Having settled the three or four heads (never more) into which the subject is to be divided, make notes under each head and on this framework construct the speech.

The opening remarks are of great importance. Endeavour to fix the attention of your audience within the first two minutes, or better with the first sentence if you can. If you fail to get the interest in your opening you cannot gain it later.

Some speakers have the faculty of opening very effectively with a story, but if this method is adopted there should be a moral which can be applied to your case. Others will use a well-known phrase such as : " The Prime Minister in the House of Commons once said ' Wait and see.' "

Perorations

The beginner should write out the whole of his speech. This method has several advantages. It involves an effort to find the most suitable words to express the thoughts, and fixes these words in the mind. It accustoms the mind to concentrate on the subject. The student will be surprised at the difficulty he will find in putting his thoughts into words until he has adopted this method, and the great benefit he will derive from the labour which it has entailed.

Your closing remarks, like your opening sentences, should be well thought out. Let them be the climax of your effort. If you wish to bring your speech to a conclusion with a quotation, or a piece of poetry, let the quotation be a short one, or the poetry not more than four or six lines, committed to memory and to the point.

Nothing carries an audience so much as well chosen word-pictures, but these require the greatest care in selection, or they may make the speaker look extremely ridiculous. They should always be carefully prepared and never used on the spur of the moment.

An orator in the House of Commons on one occasion got his metaphors mixed and declared that " The British Lion, whether climbing the pine forests of Canada or scouring the Pacific main, will never draw in its horns or retire to its shell."

A Minister on one occasion stated that " the

railways were cutting the ground from under the steamers' feet."

The speech having been written out should be revised, every sentence being carefully considered, but on no account committed to memory.

The next step is to reduce the speech to notes. Probably several deletions will be necessary before it can be brought down to its final limit, which should not exceed a card for each head.

Cards the size of an ordinary post card are most convenient, as they can be held in the hand for reference and do not double up in the way notes on paper would do. Three or four cards should be sufficient; that is to say, one card for each head.

Write on one side only, and, when the points on that card have been dealt with, place it on the table; it is then out of the way and will not confuse you.

Often a single word on the card will be sufficient to direct the mind to the point, as a man who has prepared his speech with care will be able to see in his mind's eye whole paragraphs of his original notes.

In Training

The speech having been prepared, and reduced to final notes, the work is not yet completed. The rehearsals commence. Portions should be fired off to friends, if any can be found who will listen. Even when the student is alone he should deliver portions of his speech aloud to get accustomed to the sound of his own voice, and in this way he will also get the correct pronunciation of the words.

Take every opportunity to go over the arguments in the mind, always taking care to think out the words in each sentence. This can be done in the train, on the bus, or even when walking along the street.

If you intend to enter for a race, either running or bicycling, or a boxing match, you go into training.

When you are going to make a speech, put the mind into training, and you will realise your advantage when you come to appear on the platform. You will be saturated with the subject, and have little or no room for stage fright or any of the other maladies which are common to the beginner.

We will assume that the speech is to be delivered from a platform. Some preliminary remarks will be made by the chairman. The period of waiting is probably the most trying part of the ordeal, but it has to be faced. The speaker is fortunate if the chairman's remarks are brief.

Employ the time by taking stock of your audience, and decide how you will pitch your voice so as to make yourself heard in every part of the room.

Take a glance at your notes, but do not try to read them all through. The first card will be sufficient, it will give you confidence. To try to read all your notes would only confuse you.

Place your notes on the table openly. Some speakers try to hide their notes as if they were ashamed of having them. There is no reason for it, and if the audience is aware of the fact that you have notes, it is at all events some evidence that you thought it worth your while to make some preparation.

If you have been fortunate enough to pay a visit to the House of Commons when Mr. Asquith has been speaking, you will have seen him place several sheets of notes on the historic brass-bound dispatch box, and refer to them frequently. Most Members of Parliament use notes when speaking.

Use of Notes

When you are called upon to speak, rise modestly, pick up your notes, which, of course, should be in their proper order, and stand a short distance from the edge of the platform. Face your audience and *be natural.*

Commence your remarks quietly and slowly, giving each word its full value; that is, do not slur the final syllable and run one word into another. Cultivate a pleasant manner, do not assume that the audience is antagonistic and look at them as you would look at your bitterest enemy; rather regard them as seekers after the truth.

Never attempt to bully an audience. Remember that you can catch more flies with sweetened water than you can with vinegar.

Do not be afraid of referring to your notes; the fact that you see them will give you confidence. Do not feel alarmed if you are very nervous, if you are not nervous you do not appreciate the position sufficiently. Nervousness is very trying to a beginner, but all our best speakers confess to a feeling of nervousness even after years of practice.

Again *be natural,* do not try to imitate the actions of any well-known man. Remember that you are a speaker, not a mimic, and that actions on the platform are like fashions: what suits one man may be grotesque in another.

Do not think about your actions while you are speaking. The words you speak will suggest to the brain the appropriate action, and the hands and arms will carry them out

without any appearance of striving for effect.

Appropriate actions will not come at once. It is only after some practice as a speaker, and when a degree of confidence has been attained, that gestures will come naturally, and until they come naturally they are better left out.

Do not try to make a long speech. There is a limit to human endurance, and it is much safer to stop leaving your audience wishing for more than to weary them. We mentioned the importance of the closing remarks because a speaker, unless his closing remarks have been prepared, has a difficulty in knowing when to stop. The effect of many a good speech has been lost because the speaker could not find a satisfactory conclusion.

Dealing with Hecklers

Questions are often asked, particularly at political meetings. The speaker should be prepared for these. Do not treat the questioner as if you thought he was a fit and proper subject for a lunatic asylum, or that he has been guilty of a crime in daring to put a question. He has a perfect right to ask a question, and it is your duty to answer it, and he may be giving you an opportunity to emphasise some point you have made.

If the question is put verbally let the question be put without interruption, unless it amounts to a speech, when it is the chairman's duty to interfere, not the speaker's. Repeat the question before attempting to answer it. This not only gives the audience an opportunity of hearing it, but it gives the speaker time to think over the answer he will give. Do not commence the answer by a long explanation; give the direct answer, and, if an explanation is necessary, add it.

There are always people in the audience who, although they may not agree with the speaker, will admire him for a straightforward answer. Some speakers, far too many, attempt to evade questions by smart repartee. It is not a good practice. Repartee, if indulged in at all, and under some conditions it is a most useful weapon, should be reserved for the interrupter, and in dealing with an interrupter, however irritating he may be, the greatest good humour is essential. Nothing is more fatal to a speaker than loss of temper; righteous indignation may be shown, but never loss of temper.

The lack of fluency is almost always due to a small vocabulary. One of the first duties of the would-be speaker is to try to improve his vocabulary, so that he may be able to express his ideas in various words; instead of being confined to the use of one word he may have five or six with cognate meaning, and if one word fails him he can resort to others.

Reading is the surest method by which the vocabulary can be extended, if good authors, such as Macaulay, are selected, and care is taken that the exact meaning of every word is understood.

Another method is frequent writing, with a good dictionary of synonyms at hand to which constant reference is made.

The would-be speaker should make a point of hearing good speeches as often as possible and note the management of the voice, the effect of gestures, the formation of sentences, and last, but by no means least, the eloquent pause.

The value of a pause at the right moment cannot be emphasised too much. It gives the audience time to breathe, it creates an air of expectancy.

If the pause is made after the statement of a principle to which you are opposed, the audience becomes at once interested to know how it will be dealt with, how you will meet the situation.

It is said of Sir Henry Irving that his very pause had eloquence.

Useful Hints

No attempt has been made to deal with Elocution, which is a study in itself, and is undoubtedly most important to the speaker.

The principal matters to be remembered are: Keep the lungs well filled, breathe naturally, speak slowly and distinctly, do not shout, but speak so that every one in the room can hear without straining. This can be done by addressing your remarks to a person who is seated in the third or fourth row from the back of the room.

Do not drop your voice at the end of every sentence.

Let nothing be too much trouble in preparing a speech. If you have anything to say let it be said well.

Get the sympathy of your audience, not its pity.

Don't try to see how long you can speak. Remember the audience is human, and don't go on after you have finished.

When you have made a point don't spoil it by further explanation. Remember that an audience likes to be thought intelligent. If you labour your points it is an indication they are lacking in intelligence. J. W. U.

Continued from page 240.

BUSINESS AND COMMERCE

***Contributors*:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).**

COMMERCIAL TRAINING. —XXXIII

An advertising idea must be perfectly simple and clear, easily to be understood by anyone. A chain is no stronger than its weakest link, and the writer of advertisements must remember that among the general public there are many people of poor understanding, so that his ideas must be comprehensive to those of little intellect.

As to whether an advertisement should contain a few words or many is dependent entirely upon the individual appeal, and there are no hard and fast rules; though, generally speaking, few words are better than many. But, as a flat contradiction to this ruling, we have the well-known case of the advertisements of Eno's Fruit Salt. The late Mr. Eno, who amassed a huge fortune, possessed the most original conceptions in the art of advertising. He took large spaces in the newspapers and filled his space to the utmost capacity with all sorts of matter that apparently had no bearing upon the article he was selling.

In the case of Beecham's Pills—wordiness has seldom been apparent in the advertisements of this medicine.

We will now consider in greater detail the campaign in connexion with the new breakfast food we discussed in a recent lesson.

This food has been fully dealt with in the retail trade, but there is to be a newspaper and periodical campaign and the copy and matter has to be prepared. For this purpose we will call the new food "Brekoats," which we do not claim to be an ideal name.

An appropriation is made from the funds of the promoting company and a firm of advertising agents is given the contract for handling the original publicity. Certain copywriters are approached and invited to suggest ideas for the drafting of the advertisements and an idea seeker would probably work along the following lines:—

The appeal. In this case he would play up to the imagination—A breakfast food; the importance of breakfast; foundation for the toil of the day; get a good breakfast and little more matters; the contents of the new food from an analytical standpoint, but *not* presented scientifically; value of the food as compared with other staple foods; low cost; ease of preparation.

The writer's next task would be to hit upon a novel plan and captivating form of presenting his ideas. He would plan one or two picture schemes, fancy borders, scrolls and what not; and arrange for an artist to draw them out roughly, purely for the purposes of the draft advertisement.

We will assume that the following is one of the drafts:

BREKOATS

Boys, girls, men and women, infants and invalids can take "Brekoats" to advantage. In fact, no one can afford to be without this valuable food.

If you have never tried "Brekoats" you should do so NOW ————

They will do you good.

We can imagine some attractive pictorial matter being mingled with this, which could be displayed to occupy considerable space. Now, what are the faults of this advertisement? It certainly tells a story and makes an appeal for "Brekoats," but there is a great deal lacking in its conception. In the first place, it is deficient in driving-power. When you have read the announcement you do not know what Brekoats are. You do not realise that they are delicious and tempting to the palate; you do not know where they are to be obtained; you do not even know how much they cost. There has been nothing to attract your interest, to appeal to your

imagination, and the money paid for that advertisement would be simply thrown away.

Now suppose we start again. This time we are going to narrow our appeal and draw up an advertisement to tempt women, the people who will actually buy the Brekoats. The copy must be so planned that it possesses a real lure to the housewife.

That Early Morning Bustle!

What woman does not know the bustle and scurry to prepare breakfast, especially on these dark, winter mornings. Much of this breathless rush can be saved by serving

BREKOATS—*The Ready-Cooked Breakfast Food*

BREKOATS if soaked in water over night may be served in 4 minutes.

One plate of BREKOATS contains the nourishment of TWO boiled eggs.

BREKOATS have a delicious flavour and appeal to the palate even in the early morning.

A Soothing Supper Dish

BREKOATS are bone-forming and body-building—ideal for children.

They are warming and sustaining to the Outdoor Worker.

They form a valuable brain and nerve food to the Office Worker.

Women and Mothers find BREKOATS appetising and easily digested. For invalids they are delicious.

You can obtain from your Grocer. ***1 1d., in 2lb.*** *Cartons.*

Brekoats are Grown by British Labour on the Rolling Colonial Plains

It will be seen that this advertisement makes a direct appeal. The main top line arrests the attention and the various sub-lines each tells a story. A person on reading the advertisement grasps at once the necessary points of the new food—its high value, its simplicity of preparation, its cost, where it is to be obtained and from whence it comes. Little pictures—" thumbnails " they are termed technically—might be scattered through the text so that each of the main points are emphasised pictorially.

Much of the driving power of an advertisement depends upon the choice of type that can be made. In the small-scale announcement above there has been no opportunity for employing display types. As a matter of fact, the word " Brekoats " would probably be more effective if drawn by an artist in some distinct way and reproduced not from type at all but from zinco blocks.

In any event, books containing specimens of all the types that are available for use are usually obtainable from any large firm of printers.

Frequently the happy use of a word or phrase in advertising any commodity will not only stimulate sales but maintain public interest in other products of the firm. A. B.

CHOOSING A CAREER.—XXXVII

Railways (*continued*).—In addition to the openings already enumerated for clerks, there is the Railway Clearing House, Euston Square, London, N.W.1. At this office considerably over two thousand clerks are employed, whose work it is to dissect the accounts of our railway systems and to apportion to each its percentage of earnings from traffic that passes over the lines of more than one company.

The Irish Railway Clearing House is in Kildare Street, Dublin; and, with both Houses, there is an entrance examination for candidates, who begin as juniors and then find their own level as they work their way through the service.

In the offices of the engineers and the constructive staff of a railway there is naturally a staff of clerks for the transaction of the clerical business; and some of these clerks, by means of self-education, are able to fit themselves for the technical side of the work.

In addition, there are the draughtsmen, surveyors and engineers; and, with this class of officer, there is no specified rule that they shall not be drafted into the service from outside. In the locomotive works there are premium pupils and apprentices who commence at about sixteen or seventeen years of age and serve for four or five years, paying a premium of at least £100 and receiving a small weekly wage in most cases.

Many of these apprentices remain in the employ of their parent company, but some go to other engineering work, or to other railway companies; and it may be said that the British railway companies act to a very large extent as training grounds for clerks, engineers, executive officers and high officials for the railways of our colonies and dependencies overseas.

In the works of all our railway companies there are also employed large staffs of mechanicians, fitters, carpenters, smiths, painters, turners and representatives of all the other trades whose work enters into the building of railway engines, rolling stock and appliances. Most of the men commence as boys and work their way into their trade; but, in busy times, it is possible for a skilled journeyman to find employment.

The chief works of the Great Western Company are at Swindon; of the Midland at Derby; of the North Western at Wolverton (carriages) and Crewe (locomotives); of the Great Eastern, Stratford, Essex; of the South Western, Eastleigh, Hampshire; of

Drawn by G. F. Morrell; reproduced by permission of the "Graphic."

THE RAILWAYS OF BRITAIN.

A map showing the main areas served by the leading railways and indicating the approximate number of railwaymen employed in each area.

the Great Northern, Doncaster; of the North Eastern, York; of the South Eastern, Ashford, Kent; of the Great Central, Gorton, near Manchester.

Coming now to the uniformed class of railway servants, we find that the station masters are the best paid, and that all the classes graduate upwards from one of the types of boy employment. So far as boys are concerned, they may enter the service in this class as signal cabin boys, with the duty of booking the times of trains as they pass the signal cabin; as van boys with the company's vans; as boy clerks or office boys at the stations and offices (though this class is not to be confused with the junior clerk of the head office staff), and as boy engine cleaners.

Appointments are gained by communicating either with the local station master or with the district superintendent; but station masters will invariably give advice to an applicant. In some cases a simple examination must be passed, suitable to a boy of public elementary school education, and there is also a medical test. A certificate of character, naturally, is asked for.

To explain still more closely the routine of railway promotion we will run through some of the grades. *Station masters* are of three classes. The highest class is comprised of men who manage the termini and more important stations.

Their pay may vary from £250 to £800 a year, according to the nature of their work; and these men have all had long railway experience, are of good education, sound disciplinarians, and men of marked ability. Such men are probably recruited from the clerical staff at the head office; but there is no reason why a station master of a lower grade should not in time be promoted to one of the leading stations.

The second and third grades are men who manage the smaller stations. Many of them will be paid weekly; their wages in some cases being augmented by a house, coal and light. These also may be recruited from head office personnel; but, with some of the companies these posts are reserved for booking clerks, and in some instances for guards.

Platform inspectors, who are paid according to the station and their own service, are often recruited from guards, and sometimes from the traffic superintendent's office. Passenger guards are recruited from the porter class, and in some cases from the signal cabins. Goods guards are promoted from the shunting and goods yard staff.

Booking clerks are recruited from office workers, mainly from the class that enters the smaller offices as boy clerks. In some cases booking clerks are promoted signal cabin boys; for it is often of importance that the booking clerk shall be able to manage telegraph instruments, and in cases where booking clerks are appointed by examination a knowledge of the Morse code and needle is insisted upon.

Permanent way men, linesmen and the class that constructs and maintains the line itself begin as labourers and are promoted to be gangers and then foremen. In some instances permanent way men may become goods guards, and may even obtain promotion to become passenger guards.

Engine drivers commence their careers as boy engine cleaners. The first promotion is to the position of fireman or stoker on a shunting engine; then on a goods engine; and, finally, on a passenger engine. From this point the worker will become driver of a goods engine, then of a slow passenger engine, and, in course of time, of an express.

Ticket collectors spring from the signal cabin boy class, from the ranks of boy porters and also those of the boy clerks. Travelling ticket collectors are the picked men of their class. Sleeping car attendants are usually selected from the clerical staffs of sub-offices.

The *railway policeman* is often a time-expired police constable or police sergeant, sometimes an ex-sailor or ex-soldier, and occasionally a porter who has earned promotion. The staff of the dining cars, made up of cooks and waiters, is drawn as a rule from the company's hotels department.

There are not a great many women employed by our railway companies. On some of the long-distance expresses there are women attendants to look after lady passengers and children, and these women are often trained nurses.

At the head offices of some of the companies ladies are given employment as shorthand typists and book-keepers. Application for such a post should in the first instance be made to the secretary of the particular company, copies of recent testimonials being enclosed with the application.

It will thus be seen that to take up railway work as a career it is necessary in almost every case that the worker shall commence at an early age. Only in very few instances can the middle-aged worker obtain employment at all; and the greatest importance is attached to the system that a railway servant shall have started young and have passed through the mill. A. C. M.

BOOK-KEEPING.—XXXI

In the Exercise 33 on p. 240 it was necessary to work out the interest on the drawings of the partners. In the exercise each partner was entitled to draw £45 at the end of the month, and he was called upon to pay 5 per cent. per annum interest on this amount. For the purpose of this example it would be quite in order to count this as a 1d. per £ per month, i.e. 5 per cent. is 1s. in the £ per annum. Disregarding the inequality of the number of days per month this works out at 1d. per month.

Average Due Date

In complicated examples, however, it is usual to calculate what is known as the "average due date," i.e. to find a mean date on which a single payment can be made in lieu of several payments calculated as from different dates. Similar arrangements are made in the settlement of contra accounts, realisation of book debts in partnership liquidation, and in the matter of partnership drawings. Where payment on various transactions is to be made at various dates, the following rules are applied.

Take the due date of the first transaction and calculate the number of days to the due date of each separate transaction. Using the numbers so found, multiply each number by the amount of money to be paid on the particular date to which the calculation has been made. Add these products, and divide by the total sum due on the various transactions. The result will give a number which, added to the due date of the first transaction, will give the average due date, e.g. :

Three bills were drawn (i) for £200 on Sept. 1, 19.., at 3 months' date ; (ii) £400 on Aug. 7 at 1 month's date ; and (iii) £50 on Aug. 30 payable 10 days after sight. Bill (iii) was accepted on Sept. 1. At what date would it be equitable to pay £650 in discharge of these bills ?

We have already distinguished between Capital and Revenue expenditure. It is equally necessary to be able to separate Capital and Revenue expenditure when the final accounts are presented on the double account system, or on the single account method, e.g. a boiler has been depreciated and stands on the books of the business at a scrap value of, say, £30. Suppose a new boiler is purchased for £200, the old one being taken away and £20 being allowed on it.

There is a loss here of £10 on the old boiler, and this is charged against Revenue. The cost of the new boiler would be a Capital item. In order to ascertain what must appear in the Trading and Profit and Loss Account and what must appear in the Balance Sheet, it would be necessary that the student should be able to pick out Capital and Revenue items at a glance. The following would be Capital items :—

The purchase of machinery,
The erection of buildings,
The purchase of a business with goodwill,
The purchase of a lease.

As a rule repairs, depreciation, rent, rates, taxes, legal expenses, and current expenses of carrying on a business, will be Revenue items. Even in these cases there are exceptions. Wages may become Capital expenditure when workmen are paid for assisting in providing Capital assets, e.g. the erection of plant or buildings for the use of the business. Legal expenses are generally a Revenue item, but where premises are purchased, the conveyancing cost is added to the cost of the premises, and so becomes capitalised.

Double Account System

Single and double entry must not be confused with the two methods of presenting final accounts known as the single account and the double account systems. Whichever of these two methods of presentation of final accounts be adopted, double entry is the proper system of keeping accounts. The single account system is the method we have

Date	*Amount of Bill*	*Due date*	*Days from Sept. 10*	*Product of Days by Amount*
Sept. 1	£200 – –	Dec. 4	85	85 × 200 = 17,000
Aug. 7	£400 – –	Sept. 10	—	— —
Aug. 30	£50 – –	Sept. 14	4	4 × 50 = 200
	£650 – –			17,200

17,200 ÷ 650 = $26\frac{6}{13}$. As $\frac{6}{13}$ is less than $\frac{1}{2}$ neglect it. A fraction over $\frac{1}{2}$ is counted as 1.
The amount falls due 26 days after Sept. 10, i.e. October 6.

already so often illustrated of presenting Trading and Profit and Loss Account, followed by a Balance Sheet in which all the assets and liabilities occur.

The double account system is used by various public undertakings and prescribed by Act of Parliament for Railway, Gas and Electric Light Companies. The student should be warned against considering the double account system a special system of book-keeping. The double account appears only in the last and final accounts of the financial period under consideration. It takes the form of a Balance Sheet divided into two parts, the Capital Account and the General Balance Sheet. The former deals with the fixed assets and liabilities, the latter with the floating assets and liabilities, and a peculiarity generally pointed out in the text books on this subject is the non-depreciation of assets. This is not quite accurate, as the double account system lends itself to depreciation just as much as does the single account system. At the same time it is quite possible in the single account system to show assets undepreciated, as for example, in Lesson 22. The first form of Balance Sheet showing how the Depreciation Fund and Depreciation Fund Investment appears (Vol. IV., pp. 247–8) is an example in the single account system of a fixed asset appearing in the Balance Sheet at its full value.

The second form of Balance Sheet is the more usual, showing the asset properly depreciated and showing the Depreciation Fund Investment as an asset, the Depreciation Fund itself being a deduction from the value of the asset depreciated. The double account system is provided in order that the original cost of capital assets shall not be obscured,

THE X. Y. GAS

Dr. CAPITAL ACCOUNT FOR THE

	Expenditure to Dec. 31, 19..			*Expenditure this year*			*Total Expenditure to Dec. 31, 19..*		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
To Land Acquired, including Law Costs	–	–	–	–	–	–	–	–	–
,, New Buildings, Plant, and other structures connected with manufacture	–	–	–	–	–	–	–	–	–
,, New Mains and Service Pipes and other works connected with distribution	–	–	–	–	–	–	–	–	–
,, New Meters (additional)	–	–	–	–	–	–	–	–	–
Total Expenditure							–	–	–
To Balance							–	–	–
							–	–	–

Dr. GENERAL BALANCE SHEET

	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
To Capital Account Balance							–	–	–
,, Net Revenue Balance							–	–	–
,, Reserve Fund Account Balance							–	–	–
,, Creditors—Unpaid Interest				–	–	–			
Unpaid Dividends				–	–	–			
Plant, Coal, Stores				–	–	–			
Deposits on Gas				–	–	–	–	–	–
,, Wages and Contingencies							–	–	–
							–	–	–

but even under this system depreciation is provided for by opening a Depreciation Fund Account or a Reserve for Repair and Renewals Account, which will be included as a liability in the general Balance Sheet.

The Capital Account represents the balances of capital receipts and payments as they appear in the Capital Account Ledger of the undertaking. The receipts will consist of shares, stock, debentures, etc., whilst the assets purchased with these receipts will appear on the other side.

The second portion of the double account is the General Balance Sheet—the balance brought down from the Capital Account, the floating assets, such as stock, cash, debtors, etc., and fluctuating liabilities, including creditors, reserves, etc.

In addition to the foregoing, a public undertaking which presents its final account on the double account system will frame a Revenue Account, a Net Revenue Account and a Reserve Fund Account. The balance of the Net Revenue Account and the Reserve Fund Account will, of course, appear on the liability side of the General Balance Sheet.

The Revenue Account corresponds to the Trading and Profit and Loss Account of an undertaking presenting its accounts on the single account system. The balance on the Revenue Account is carried to the Net Revenue Account, which partly corresponds with the Appropriation Account, but may contain other items which would properly appear in the Profit and Loss Account of an ordinary undertaking. Reference to the Pro Forma Accounts of the X.Y. Company (see pp. 294, 295, 296) will indicate the form in which accounts are presented.

COMPANY

YEAR ENDED DEC. 31, 19.. *Cr.*

	Certified Receipts to Dec. 31, 19..			*Received during Year*			*Total Receipts to Dec. 31, 19..*		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
By Ordinary Stocks	–	–	–				–	–	–
„ Debenture Stocks—									
Five per cent.	–	–	–				–	–	–
Four per cent.	–	–	–	–	–	–	–	–	–
„ Mortgages	–	–	–	–	–	–	–	–	–
							–	–	–

ON DEC. 31, 19.. *Cr.*

	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
By Cash at Bankers				–	–	–			
„ Cash at Offices				–	–	–	–	–	–
„ Amounts Invested—									
Reserve Fund							–	–	–
„ Stock—Coal				–	–	–			
Coke and Breeze				–	–	–			
Tar and Other Products				–	–	–			
Sundry Stores				–	–	–	–	–	–
„ Debtors—Gas, etc., to—									
Sept. 30, 19..	–	–	–						
Dec. 31, 19..	–	–	–	–	–	–			
Rentals, Meters				–	–	–			
Coke, etc.				–	–	–			
Sundries				–	–	–	–	–	–
„ Gas Stoves and Fittings							–	–	–
							–		–

Dr. NET REVENUE ACCOUNT FOR THE YEAR ENDED DEC. 31, 19.. *Cr.*

	£	s.	d.	£	s.	d.		£	s.	d.	£	s.	d.
To Interest on Mortgages accrued due ..				–	–	–	By Balance from Last Account	–	–	–			
,, Interest on Debenture Stocks—							Less Dividends Dec. 31, 19..	–	–	–	–	–	–
Five per cent. ..	–	–	–										
Four per cent. ..	–	–	–	–	–	–	,, Balance from Revenue Account being Profit for Year to Dec. 31, 19..				–	–	–
,, Dividends on Ordinary Stock to June 30, 19..				–	–	–							
,, Balance Net Profit available for Dividends on Dec. 31, 19..				–	–	–							
				–	–	–					–	–	–

THE X.Y. GAS COMPANY

Dr. REVENUE ACCOUNT FOR YEAR ENDED DEC. 31, 19.. *Cr.*

	£	s.	d.	£	s.	d.		£	s.	d.	£	s.	d.
To Manufacture of Gas—							By Sale of Gas—						
Coal, Oil, etc. ..	–	–	–				Private Consumers ..	–	–	–			
Purification	–	–	–				Public Lighting ..	–	–	–	–	–	–
Salaries of Engineers and Clerks	–	–	–										
Wages at Works ..	–	–	–				By Rental of Meters ..	–	–	–			
Repairs and Maintenance of Works, etc.	–	–	–	–	–	–	,, Rental of Stoves ..	–	–	–			
							,, Rental of House Fittings	–	–	–	–	–	–
To Distribution of Gas—													
Salaries of Surveyor and Inspectors ..	–	–	–				By Sale of Residual Products—						
Repairs and Renewal of Mains, Service Pipes, etc., including Materials and Labour	–	–	–				Coke, less Labour and Cartage	–	–	–			
							Breeze	–	–	–			
Repairs to Meters ..	–	–	–				Tar	–	–	–			
Repairs to Stoves ..	–	–	–				Sulphate of Ammonia	–	–	–	–	–	–
Repairs to Fittings..	–	–	–	–	–	–	By Rents Receivable ..				–	–	–
To Public Lamps—													
Lighting and Repairing				–	–	–							
To Rent, Rates and Taxes—													
Rents	–	–	–										
Rates and Taxes ..	–	–	–	–	–	–							
To Management—													
Directors' Fees ..	–	–	–										
Salaries of Office Staff	–	–	–										
Stationery and Printing	–	–	–										
Auditors' Fees ..	–	–	–										
General Expenses ..	–	–	–	–	–	–							
To Bad Debts				–	–	–							
Balance to Net Revenue Account ..				–	–	–							
				–	–	–					–	–	–

F. H.

Continued from page 248.

HISTORY:

Contributors:—J. A. Brendon, B.A.(Oxon.), F.R.Hist.S.; F. Collinson, F.R.Hist.S.; T. P. Evans, B.A.(Oxon.); James A. Manson; L. Stampa, M.A.(Oxon.); and J. B. Sterndale-Bennett.

FRANCE UNDER LOUIS XIV.—II

It is a significant gloss on the Latin maxim *Si vis pacem, para bellum*, that when Louis was prepared for war he sought and generally found it. Being the man he was he determined to take full advantage of the means he had been at the trouble to provide in order to satisfy his craving for *la Gloire*.

In 1665 a question arose which involved, as he interpreted it, a legitimate *casus belli*. Philip IV. died in that year. He had been twice married and the only child of his first marriage, Maria Theresa, had renounced her rights to her father's dominions when she married Louis. The latter, however, now furbished up a feudal custom in vogue in Brabant and Hainault, called the Law of Devolution, by which the children of a first marriage inherited the father's property, to the exclusion of later descendants. He maintained that this local custom overrode his wife's renunciation and therefore he claimed the Spanish Netherlands (now Belgium).

War of Devolution

Diplomacy proving useless, the War of Devolution broke out in June, 1667. Spain was totally unable to contend with France, and Turenne, sustained by the august presence of his master, at the head of an army of 50,000 men, reduced one town after another in Flanders, while Condé overran Franche Comté.

The answer to these disquieting successes was the formation—through the instrumentality of Sir William Temple and John de Witt—of the Triple Alliance of Great Britain, Holland, and Sweden. The Allies intimated that unless their mediation were accepted they should invade Flanders. Louis, for once deeming discretion the better part of valour, acquiesced, and the Treaty of Aix-la-Chapelle was signed on May 2, 1668, by which France kept most of the fortresses in the Netherlands, but retired from Franche Comté. But Louis had the satisfaction of knowing that in his archives lay a secret treaty, signed a few months earlier, in which the Emperor Leopold I. had agreed that if Charles II. of Spain died childless, the Spanish Netherlands should fall to the French king.

Louis, nevertheless, resented the audacity of the Dutch in presuming to cross his purposes and set to work to undermine the Alliance and punish the United Provinces.

Battle of Southwold Bay

The English king (Charles II.) was venal, and contracted, in the disgraceful Secret Treaty of Dover (1670), to join France in a war against Holland for a yearly subsidy of 300,000 francs and the acquisition of Walcheren with control of the mouths of the Meuse and Scheldt. Sweden, an old-time friend of France's, was readily persuaded to attack Germany should she side with the Republic, and the German princes, save the Great Elector, Frederick William of Brandenburg, undertook to remain neutral.

The train was now laid and in 1672 the wily king fired it.

By sea the Dutch held their own, defeating the Anglo-French fleet in Southwold Bay (June 7), but on land they were outmatched by the armies under three of the most distinguished generals of the age—Condé, Turenne, and Marshal Luxembourg—and towns fell in quick succession. These disasters revived the miserable squabbles between the Burgomasters' faction and the Orange party, but the latter were strong enough to carry the election (July 8) of William of Orange as Stadtholder, with command of the army and navy. This did not allay the rage of the mob, which eternally disgraced itself by the shocking murder of John and Cornelius de Witt (August 20).

What stayed the advance of the invader was the cutting of the dykes, while William's dauntless resolution restored the drooping spirits of his adherents.

Next year (1673) the French maintained their advantage. Turenne, displaying masterly strategy, crossed the Rhine and reduced Westphalia, whereupon the Great Elector made terms and retired from the contest. Luxembourg was still too strong for William, and Vauban compelled the surrender of Maestricht (June 29), but on their own element the Dutch checked every effort of the hostile fleet to descend on their coast.

The Powers, driven to greater energy, formed another coalition. Leopold ignored his secret treaty and, along with Spain, Denmark, Saxony, and the Duke of Lorraine, decided to aid Holland. William, at the head of an Imperial, Spanish and Dutch force, besieged and took Bonn (November 12) and obliged Turenne to return to France. Louis lost command of the Rhine and was reduced to the defensive. The English people now peremptorily interfered and insisted upon peace with Holland (February 19, 1674). Louis was thus isolated.

Death of Turenne

William was the heart and soul of the Coalition, and though the campaign of 1674 went against him his military reputation was actually enhanced. Louis' brilliant generals, too, were seen at their best. Condé fought a severe though indecisive battle at Seneff (August 11), Franche Comté was conquered again, and Turenne crushed the Imperialists at Sinzheim (June 16), but tarnished his name by desolating the Palatinate. Another victory awaited him at Enzheim (October 4) and later he defeated the Great Elector, who had again taken the field, at Colmar (January 5). Turenne's dashing course, however, was nearly run, for he was killed at Sasbach in Baden on July 27, 1675, and with his death the more conspicuous French successes closed.

Curiously enough, Condé's service also terminated this year. He succeeded to Turenne's command, but after clearing Alsace of the Imperialists was disabled by gout and retired into private life (d. 1686). At Fehrbellin, 1675, the Elector crushed the Swedes, and Louis was now free to play the part of *Ludovicus contra mundum.*

With three victories in the Mediterranean, 1676 opened brightly for the French King. Duquesne defeated the combined Dutch and Spanish fleets off Stromboli (January 8), Agosta (April 22), where the illustrious de Ruyter was mortally wounded, and Palermo (May 22). But grave discontent at home turned Louis to thoughts of peace, and he threw out several feelers, to which neither William nor the Emperor was responsive. However, the continued success, though on the minor scale, of the French arms in this and the following year, together with the exhaustion of the United Provinces and the clamour of the Dutch merchants and Peace party, forced William's hands, and the Treaty of Nimeguen between France and Holland was signed on August 10, 1678. Holland lost nothing, but France gained Franche Comté and several fortified towns in the Spanish Netherlands.

Louis emerged from the struggle decidedly stronger in Europe, and with an enormously exaggerated opinion of the King of France. He built the Palace of Versailles worthily to accommodate so exalted a personage.

Alsace becomes French

Louis knew the uses of intimidation. While the war-weary nations now hastened to disband their armies, he kept his at war strength. The reason soon became apparent. He coveted more territory in the east, especially Luxemburg and the rest of Alsace, not only to strengthen his frontiers, but to sustain his pretensions to the Imperial dignity on Leopold's demise. The Treaty of Westphalia (1648) had assigned to France Metz, Toul and Verdun, and their "dependencies." This proved a blessed word. He set up at Metz, Besançon, Breisach, and elsewhere grossly illegal tribunals called *Réunions* to investigate the nature of the "dependencies." Needless to say, these chambers decided that what was not explicitly ceded by the Peace must be regarded as a "dependency."

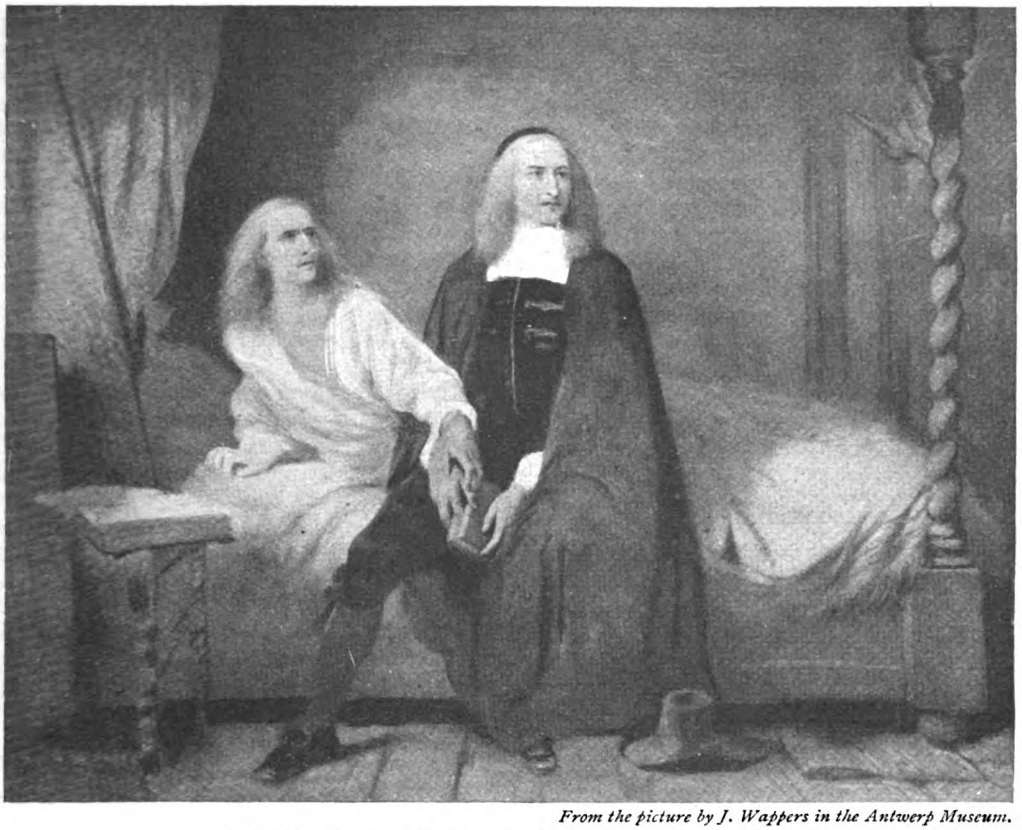
Fortified with this ruling Louis attacked and occupied Strasbourg on September 30, 1681, on which day, too, he acquired the Italian fortress of Casale. Three years later he besieged and captured Luxemburg. Thus he could ensure the votes of the Electors of Mainz, Cologne, and Trier and of the Elector Palatine, should his designs on the Empire mature. Meanwhile the twenty years' Truce of Ratisbon (August 15, 1684), concluded with Spain, Holland and the Empire, offered promising support to his ambitions.

Home affairs, with one exception, Louis habitually despised as beneath his notice. That exception was the Church. The older he grew the deeper became his attachment to it, owing to the influence of his confessor Père La Chaise and Madame de Maintenon. In fact, within the domain of doctrine and faith, he stood in awe of it. But outside of this sphere he insisted that the ecclesiastical

prerogatives of the Crown were unassailable, and he meant to be as absolute here as he was in the political, civil, and military concerns of the State.

As to the Royal prerogatives, the most important was the *Droit de Régale*, or Crown right to the revenues of vacant bishopries and the patronage within the bishops' gift. Hitherto the sovereign had refrained from exercising this right in the southern provinces of Guienne, Languedoc, Provence and Dauphiné, but Louis intended to put an end to this exemption. Though Innocent XI. forbade him to prosecute his design, the King convoked an assembly of the clergy in 1681 to discuss the situation.

In March, 1682, the clerics unanimously passed a Declaration setting forth (1) that the Pope's jurisdiction did not extend to things temporal; (2) that a General Council was superior to the Holy Father; (3) that the rules, customs, and institutions of the Gallican Church were outside of the Pontiff's authority, and (4) that in matters of doctrine Papal decisions were only valid when they had been ratified by the entire Church. Louis triumphed, but his orthodoxy remained totally unaffected and he was as "rigidly righteous" as ever. Apart from its political aspect, Gallicanism was, in a way, a challenge to Ultramontanism. Yet it was not this that gained for it Louis' favour, but the fact that it committed its supporters to thick-and-thin belief in the Divine Right of Kings.



From the picture by J. Wappers in the Antwerp Museum.

CORNELIUS AND JOHN DE WITT IN THE PRISON,

where they were foully murdered by an angry mob (Aug. 20, 1672) as a result of the wave of loyalty to the House of Orange which swept over the Netherlands in consequence of the aggression of Louis XIV.

Having vindicated their legal rights against Rome the clergy deemed it politic to strike a blow for the Pope. Egged on by the Jesuits, Louis concerted measures to establish uniformity of religion. Since 1666 the Reformed Church had been harassed in a variety of paltry, spiteful ways, but the King now sanctioned a comprehensive course of cruel persecution. Public worship was forbidden to the Huguenots, their ministers were exiled, their schools were closed, emigra-

tion was prohibited, the sanctity of their homes was violated, and soldiers were quartered on their families, no circumstance of brutality being spared to compel men, women and children to abjure their faith. Even these infamies did not glut the Jesuits' vindictive ire, and Louis was at last prevailed upon to sign a deed revoking the Edict of Nantes (October 22, 1685). The Royal treachery aroused consternation in every country but Great Britain, where James II., who had as much bigotry as the French King but little of his ability, was already lavishly feeding the discontent of his subjects. Roman Catholic sovereigns and even the Pope realised that Louis' intolerant and aggressive policy was a formidable menace to European peace.

Without delay there was formed (1686) for defensive purposes the Augsburg Alliance, which finally comprised the Emperor, Spain, Holland, Sweden, Frederick William of Brandenburg, the Elector of Bavaria and nearly all the German princes, and the leading independent States of Italy, Innocent XI. lending it benevolent support.

Louis' Rash Policy

The only Power that stood outside of the League was Great Britain, whose sorry isolation, however, was not to last long. On June 10, 1688, a son and heir was born to James II., and hopes of a Protestant succession were abandoned. The leaders of the British malcontents, whose name was legion, at once invited William of Orange to secure the Protestant rights and liberties of their country. Their prayer fell on expectant ears and William, nothing loath, made ready to answer the call. The chance of his life had come and it should be war *à outrance*.

Again signally failing to read the signs of the times, Louis chose this inopportune moment actively to intervene in German affairs, still with an eye to the Empire, although his inhuman behaviour to the Huguenots ultimately destroyed whatever chance he may have had by alienating the Electoral Princes. Maximilian Henry, Elector of Cologne, who had virtually been his vassal, died in June, 1688, and Louis put forward Cardinal von Fürstenberg as candidate for the Electorate, but the latter did not secure the necessary two-thirds majority. Thereupon the Emperor referred the issue to the Pope and Innocent XI., having good reason to distrust Louis, pronounced the minority candidate, Prince Joseph Clement, brother of the Elector of Bavaria, the lawful Archbishop of Cologne. The French King then intimated that he would support Fürstenberg *vi et armis*.

In the critical situation in which he stood this was a mad decision. Had he attacked Holland by land, or bidden his fleet "contain" William of Orange in his own country, he would have kept Great Britain out of the fray. Of course, his invasion of Germany was William's opportunity, for the Prince at a second attempt sailed for England and landed at Brixham on Tor Bay on November 5, 1688, and in due course he and his wife Mary were crowned King and Queen of Great Britain (April 11, 1689). Louis' ignorance of his own naval superiority was such that the passage of William and his forces to Ireland, where the abdicating king had a large and enthusiastic following, was undisputed, and at the Boyne the Stuart cause was broken for ever on July 11, 1690.

Strange to say, Admiral Tourville had won, on the day before, a remarkable victory off Beachy Head, though he neglected to pursue his advantage when he had the remnant of the British and Dutch fleets (for the Allies had lost from twelve to sixteen vessels), as well as the Channel, at his mercy.

British Sea Power

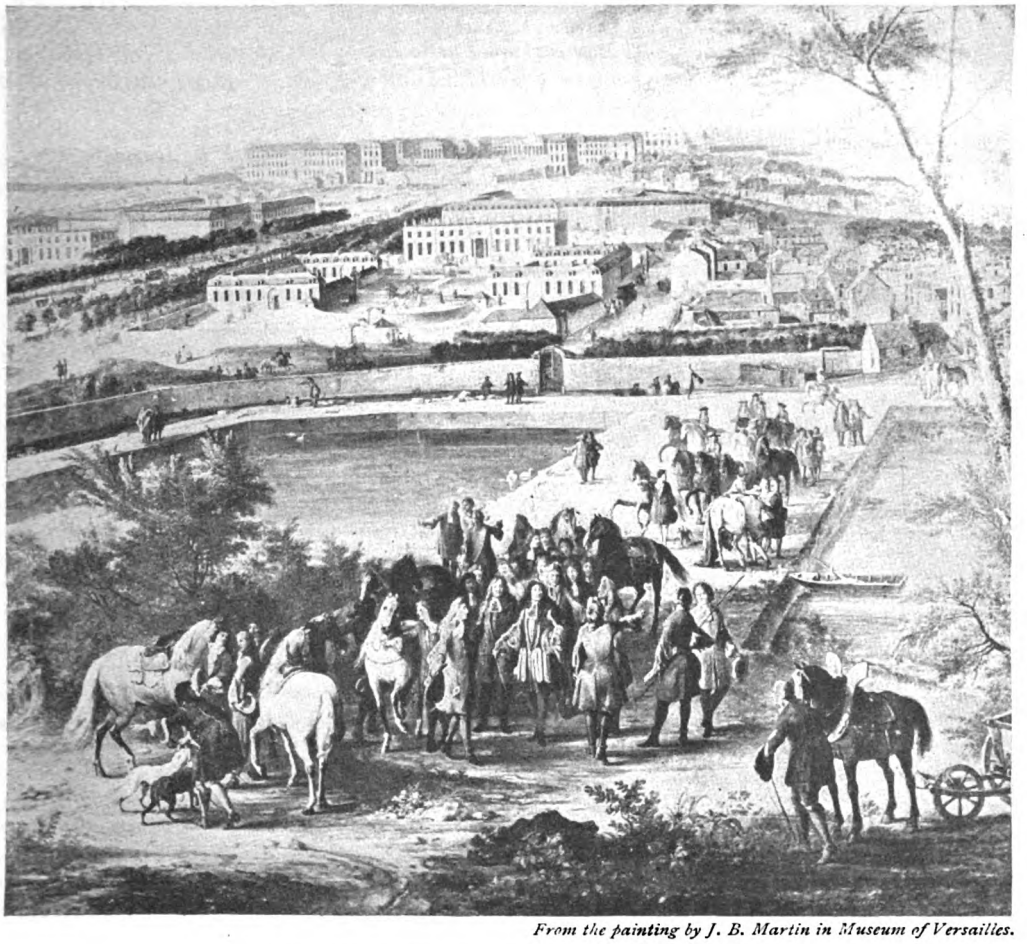
Two years later Tourville was the victim of ill fortune, for after an indecisive engagement with Admiral Edward Russell's numerically superior fleet (May 29), he lost, while conducting the retreat next day, fifteen of the finest ships in the French navy off Cape La Hogue, a disaster which restored the sea-power to Great Britain.

On land, though warfare lasted for seven years, the campaigns were singularly inconclusive. There were gains and losses on both sides, but in none did the result assume the nature of a decisive turning-point. Louis' readiness gave him a substantial send-off, but his cause was sullied by the savage and cold-blooded devastation of the Palatinate (1689).

In the Netherlands the struggle was most obstinate, the chief incidents being Luxembourg's victories at Fleurus (1690), Steinkirk (1692), and Neerwinden (1693); Vauban's masterly sieges ending in the capture of Mons (1691) and Namur (1692); and William and Cohorn's brilliant recapture of Namur (1695). The death of Luxembourg in 1695 coincided with and doubtless caused a pause in the tide of French victories, and Louis began to look for peace. He had a partial success by bribing the self-seeking

Victor Amadeus II. of Savoy to withdraw from the Alliance.

As usual William stood out for a fight to a finish, but England and Holland thought otherwise, and on learning that Louis was prepared to yield with solid sacrifices, he called a halt. By the Treaty of Ryswick (September 20, 1697) Louis recognised William as King of Great Britain and Ireland, and his sister-in-law Anne as his successor; restored all places captured since the Treaty of Nimeguen, with the exception of Strasbourg and Landau; retired from the right bank of the Rhine; agreed to allow the Dutch to garrison the chief forts in the Spanish Netherlands, and to conclude an advantageous commercial treaty with them; withdrew his candidate for the Electorate of Cologne; handed back Lorraine, saving Saarlouis, to Duke Leopold, the son of Charles IV. Altogether the Treaty was of a properly humiliating character. Yet the immediate future showed that Louis knew quite well what he was about, and only stooped (as he hoped) to conquer.



From the painting by J. B. Martin in Museum of Versailles.

VERSAILLES IN THE TIME OF LOUIS XIV.

The beautiful and magnificent palace which, originally designed in 1632 as a hunting-box by Louis XIII., was greatly enlarged between 1661 and 1687 by Louis XIV., and became the chief residence of the Kings of France.

Charles II., the last king of the Habsburg dynasty in Spain, had been sickly all his life, and died on November 1, 1700. In anticipation of a threatened partition of his monarchy, and being childless, he had made a will acknowledging as heir to his dominions the infant prince, Joseph Ferdinand of Bavaria, the son of the Elector Maximilian Emanuel, who had married Maria Antonia, daughter of the Emperor Leopold I. and his wife Margaret, the second

surviving daughter of Philip IV. This was legally the most valid succession, but the question was complicated by the pretensions of other Powers. Though Maria Theresa, Philip IV.'s eldest daughter, had formally renounced her claims on her marriage to Louis XIV., the French King held that the rights of her descendants could not be thus voided; the contention is obviously more than doubtful, but less than this would have served Louis' purpose. So he advanced the claims of his own issue. The Emperor, on his part, had persuaded his daughter to transfer her right to himself as grandson of Philip III., but it is equally obvious that she could not alienate the rights of her own child, the young Prince already named.

But the Maritime Powers, Great Britain and Holland, to which the maintenance of their share in Spanish commerce and the carrying-trade was vital, could not view the rivalry of France and Austria with unconcern. Louis affected to realise this, and a treaty of partition was signed at The Hague on October 11, 1698, by which the Electoral Prince was recognised as the chief, but not sole heir to the Spanish monarchy. To him were assigned Spain proper, the Netherlands and the Indies; the Dauphin was to get Naples, Sicily, certain Tuscan coastal towns, and Guipuzcoa; and the Milanese was to go to Leopold's second son, the Archduke Charles.

Seeds of War

When the details of this treaty, which coolly ignored the sentiments of the Spanish people, became known, indignation throughout the Peninsula was boundless and, to save the integrity of his dominions, Charles II. drew up the will aforesaid. But the death of the young Prince (February 5, 1698)—not without suspicion of foul play—upset both will and treaty and, in the hope (real or false) of averting a general war, a second treaty of partition was agreed upon (March 25, 1700). Under this deed Spain, the Indies, and the Netherlands were given to the Archduke Charles, provided that they should never pass to the Habsburgs in Austria; the Dauphin was to receive the territories allotted to him in the former treaty, in addition to the duchy of Milan, which might be exchanged for Lorraine, if the Duke of Lorraine were willing.

In Spain feeling ran high as ever at the persistency of the Powers in carving up the empire. Louis saw his chance and secretly fomented the people's anger. Charles in despair appealed to the Pope, and Innocent XII. advised that, as France was the only Power strong enough to resist the dismemberment, the King should declare the Duke of Anjou, the Dauphin's son and Louis' grandson, heir to the undivided Spanish realm, on condition that he renounced for himself and his heirs all claim to the throne of France. Charles accepted the advice, made a fresh will accordingly (October 2, 1700), and, on the King's death within a month, the Duke of Anjou was proclaimed Philip V., to the intense gratification of the Spanish people.

The Grand Alliance

Without ado Louis cast aside his treaty obligations and warmly welcomed the new King, who soon showed himself a chip of the old block by ordering the Dutch garrisons to vacate the Barrier fortresses and replacing them with French soldiers. Public opinion in England had been perfectly indifferent to the problems of the Spanish succession, and William's hopes had been viciously thwarted by the Tory majority in Parliament. He took their disaffection so much to heart that he even contemplated returning to Holland. But his truer self prevailed, and fears as to their mercantile interests—for Louis had procured for French traders the Asiento, or monopoly of the supply of slaves to the Spanish Indies—at length wrought a revulsion of feeling which brought the House of Commons into line with the national wishes.

With due dispatch the Grand Alliance was constituted at The Hague (September 7, 1701) by the Emperor, Holland, and Great Britain. Looking forwards, Austria was to receive Milan, Naples and Sicily; the Barrier fortresses were to be restored to the Dutch, and conquests in the West Indies were to be assigned to the Maritime Powers, whose commerce and navigation were also to be safeguarded.

Nine days later James II. died at St. Germains and Louis, in violation of his plighted word, acknowledged his son as James III. If anything were needed to rivet the fidelity of the British people to William's project, this shameless dictation supplied stimulus and to spare. Unhappily William died on March 19, 1702, and was thus prevented from playing the part in the coming war for which he had studiously schooled himself, but his views and purpose were shared by the Grand Pensionary, Anthony Heinsius, and the Duke of Marlborough, both of whom, along with the famous Austrian commander, Prince Eugene,

inspired the policy of the Alliance with a resolution as inexorable as that cherished by the dead king.

Hostilities broke out in 1701 on a humble scale in North Italy, where Prince Eugene defeated Marshal Villeroi at Chiari (September 1) and, in a raid on Cremona, captured Villeroi himself (February 1, 1702).

Warfare opened out, however, in 1702, when Louis found that the only assistance he could rely upon against the powerful array of his enemies was that of the Electors of Bavaria and Cologne, Duke Victor Amadeus II. of Savoy, and Portugal, while Spain, of course, was with him solid, excepting the province of Catalonia. The French King had two brilliant opponents in the Duke of Marlborough, as dashing, resourceful, and alert on land as Nelson was to be on sea in the Napoleonic Wars, and Prince Eugene, a great strategist, quick to perceive and prompt to act.

Marlborough's Campaigns

In 1702 the engagements were useful rather than showy. The French, under Marshal Catinat, were driven out of Landau on September 11, Marshal Villars retaliating by beating Lewis, the Margrave of Baden, at Friedlingen on October 14. Marlborough was uniformly successful in his sieges, capturing, among other places, Kaiserswerth (June 15) and Liége (October 23), the former success enabling him to overrun the Electorate of Cologne next year and take Bonn (May 18).

But in 1703 the French scored somewhat heavily, owing to the incompetence or laziness of the Imperial commanders in Wurtemberg and Bavaria. Vienna itself might have fallen but for the divergent views of Villars and the Elector of Bavaria. The former wished to push on to Vienna, but the latter urged an invasion of Tyrol in order to cut off Austria from Italy. On their native hills the Tyrolese feared no foe, and drove the Elector back to Bavaria ; but better luck attended Villars, who severely handled the Franconians at Höchstädt (September 20).

On the Rhine, too, the Allies sustained several reverses, Marshal Tallard taking Breisach (September 8) and recapturing Landau (November 21), but these successes were more than balanced by the secession of Portugal to the Grand Alliance (May 16) and the defection (October 25) of the Duke of Savoy, which saved Austria from present risk of assault from Italy.

Vienna, however, was still the objective and was only rendered secure by Marlborough's consummate strategy. Under feint of turning the French position, he dashed from the Netherlands (May, 1704) by the Rhine, Main and Neckar to the Danube, where his junction with Eugene and the Margrave provided the French with other employment than an excursion to Vienna. While Eugene watched Tallard at Stolhofen, Marlborough stormed Donauwörth (July 2) and dispatched Lewis to besiege Ingolstadt.

Meanwhile the French realised the gravity of their case and Villeroi hastened from the Netherlands to reinforce Tallard, who then posted on to meet the Elector at Augsburg.

Eugene, who had taken Villeroi's measure, finding that he remained inactive, pressed on to Höchstädt. Here the French proposed to crush him, but Marlborough hurried up in time to support the Prince and the Allies decided on an immediate offensive at Blenheim (August 13, 1704). The Allies numbered 52,000 men, the French 56,000, but Marlborough and Eugene's assurance of success was signally justified. Tallard had no fewer than 14,000 casualties and lost 11,000 prisoners and 100 guns, while the renown of the French army suffered a deadly blow.

Capture of Gibraltar

The French retreated beyond the Rhine, Landau was captured again (November 23), and Louis was now deprived of the support of both Electors. Nor was Blenheim the Allies' only striking gain in 1704, for Sir George Rooke captured Gibraltar (August 4) and made good the British command of the Mediterranean. His drawn battle with the Count of Toulouse off Velez Malaga a few days later (August 24) was strategically of pronounced value, as the Frenchman owned himself unable to resume the contest by retiring to Toulon.

Marlborough's plan of an invasion of France by the Moselle and Saar in 1705 was stultified by the inertness of the Dutch (singularly dilatory in military operations) and by the death of Leopold (May 5), who was succeeded by Joseph I. Consequently the year was spent in comparative inactivity, the French confining themselves to a defensive policy.

Next year made amends, for Eugene routed the French at Turin, where Marsin was slain (September 7), and as a result of his skilful manœuvring the French evacu-

From the painting by Alaux at Versailles.

THE BATTLE OF VILLA VICIOSA (1710),

in Spain, which resulted in a victory for French arms, did much to sustain the hopes of Louis XIV. and to help his subjects to recover from Marlborough's hammering blows, as also did——

ated North Italy, the withdrawal being assented to in the Convention of Milan (March, 1707). In the Netherlands Marlborough won a momentous victory at Ramillies (May 23), which gave the Allies Brabant and most of Flanders.

However, in Spain it was apparent that, excepting Catalonia, Aragon, and Valencia, Philip V. had a strong hold on the affections of the people.

The Allies ventured to invade the country, even occupying Madrid, but they had to retire after a complete defeat at Almanza on April 25, 1707. In this year the French accomplished a raid into South-Western Germany, where they plundered freely and laid the country under large contributions of money, and where Villars stormed the lines of Stolhofen towards the end of May.

The Elector of Hanover compelled them to retreat eventually, but the invasion had answered its purpose in dislocating Marlborough's scheme of campaign and in rendering abortive Eugène's projected attempt on Toulon.

But the following year the former delivered another smashing blow at Oudenarde (July 11, 1708), where nightfall alone preserved the Dukes of Vendôme and Burgundy from annihilation, and afterwards reduced Lille (Vauban's *chef d'œuvre*), the fortress being compelled to surrender on December 9.

Ever since 1706 Louis had been quietly feeling his way to peace, but the Allies declined to negotiate save on the impossible terms of the renunciation of the Spanish monarchy by the Bourbons. Now France was financially exhausted, the grisly spectre of Famine had appeared, and the people were reduced to such straits that fears of rebellion were entertained. In 1709, accordingly, the Marquis of Torcy, Louis' Foreign Secretary, offered very weighty concessions, but the Allies would not budge

From the painting by Alaux at Versailles.

——THE BATTLE OF DENAIN (1712),

another great French victory in which Prince Eugène, forced by the Emperor's stupidity to continue the war single-handed, suffered a disastrous defeat at the hands of Marshal Villars.

from their former stipulation and made it more irksome by requiring the King to use force, if necessary, to evict his grandson from Spain.

Louis at once addressed a manifesto to his people recapitulating the course of events, asking their help in his and their extremity, and committing the cause of France to Divine protection. Even in their distress the people could not read their aged King's appeal unmoved and, all classes rallying to his call, furnished Villars with another army of 90,000 men.

The battle of Malplaquet, which ranks the bloodiest of the War, followed (September 11, 1709), in which Villars was wounded and the Allies' casualties greatly outnumbered those of the French. Nevertheless, the latter were obliged to retreat, and Mons, already in siege, surrendered (October 9). The efforts of the Allies did not meet with success on all fronts.

Ill luck dogged the footsteps of the Allies in Spain, where their only real gains (apart from victories on the battlefield that had no bearing on the issue) had been the capture of Gibraltar, already mentioned, and Minorca (1708).

The Allies, as a matter of fact, had occupied Madrid once more (1710), but the Spanish capital has no military importance, and in their retreat to the coast Vendôme soundly thrashed them at Brihuega on December 10, and at Villa Viciosa two days later. The Archduke Charles could only count on Catalonia, and in this region his hold was growing more and more precarious.

Marlborough's work in the Netherlands in the same year was confined to sieges, because the French would not waste men in pitched battles, being content to fight as best they could behind stone walls. Douai fell on June 26, and other places later, the while Villars was building the lines from the Canche to the Sambre which should bar

the invader's road into France. That they were not impregnable Marlborough proved next year by capturing Bouchain (September 13, 1711), after a siege conducted in his best manner. It was his final feat, and worthy of the master.

Hard fighting being at a discount, peace negotiations were resumed and Fortune now favoured Louis. Joseph I. died suddenly (April 17, 1711) and the Archduke succeeded him as Charles VI. A topsy-turvy situation was created, for the Grand Alliance had lost its *raison d'être*. It was unthinkable that the Powers could continue to put forth superhuman efforts to place the crowns of Spain and Austria on the same head and so revive Charles V.'s unwieldy empire with its perpetual threat to Europe. Further, in England the Whigs had been turned out of office and the Tories were ready and willing to talk peace. Henry St. John and Robert Harley, their strong men, procured the dismissal of Marlborough (December 31, 1711) on the false and flimsy charge that he had embezzled public money—probably the most unpatriotic act in the history of party politics. Excepting the new Emperor, all the Powers were anxious for a settlement, and on May 11, 1713, the Treaty of Utrecht was signed.

Treaty of Utrecht

Philip V. was recognised as King of Spain and the Indies (he had already renounced all claims to the French throne, while the Dukes of Berry—Louis' grandson—and Orleans—Louis' nephew—similarly renounced theirs on Spain). As for Great Britain, the Protestant succession was admitted; the Stuarts were banished from France; the fortifications of Dunkirk were dismantled (though it says little for Louis' sense of honour that he began to construct a deeper harbour at Mardyk close by, these works, however, being afterwards demolished on complaint from England); Gibraltar and Minorca were ceded by Spain, and Newfoundland, Nova Scotia, and Hudson Bay by France; and favourable commercial treaties were concluded with France and Spain, the latter country granting the Asiento, or slave-supply monopoly. To the Dutch were assigned the Barrier fortresses they desired, the rest of the Netherlands going to Austria. The advance of Prussia to the status of kingdom was recognised, and she also received Upper Gelderland. Sardinia was elevated to a kingdom and given to Victor Amadeus II. of Saxony.

Unhappily the Emperor's stupid obstinacy compelled Prince Eugene to continue the war against France almost single-handed, and Villars defeated him disastrously at Denain (July 24, 1712). On his retreat he was unable to relieve Landau, which fell on August 26, 1713, and Freiburg, which held out until November 17. The Emperor, sobered by adversity, had to pocket his pride and accept the Peace of Rastatt (March 7, 1714), the chief points of which were the reinstatement of the Electors of Cologne and Bavaria, and the cession to France of Landau and Strasbourg. Louis gave up Breisach, Freiburg, and Kehl, but was mean-spirited enough to withhold from Charles VI. the opportunity of protecting, if he could, the interests of Catalonia, which had made such sacrifices for him. Indeed, the Utrecht diplomatists must share the blame with Louis for their shabby desertion of the brave Catalans.

Louis' Last Days

Louis, now 75, was doomed to go down in sorrow to the grave. The mild-mannered La Chaise had passed away (1709), and his place was filled by Michael Tellier, a gloomy, intolerant and truculent priest, bent upon compelling the King to crush the Jansenists, amongst whom were some of the saintliest and most cultured men and women in France.

The Jansenists were a kind of evangelical Reforming party within the Church of Rome.

They strove to uphold experience and reason as against authority of the priests, and insisted that ritual or formalism were not enough; man must prepare himself inwardly for the grace which he was or was not predestined to receive. For not all would be chosen, and in this idea of predestination the Jansenists were not unlike the Calvinists.

They denounced wholeheartedly the Jesuits' lax moral code, which was undermining character wherever they held sway. In this the Jansenists had a supreme advocate, Blaise Pascal,* who was not only a scientist, but one of the greatest men of letters in French literature. Louis' unreasoning ideal of One Nation, One Church, made him an easy prey to his confessor's wiles, and the cruel usage of the Jansenists which now ensued, together with his treatment of the Huguenots, ranks him among the world's most craven persecutors. Nothing, moreover, could be more detrimental to the in-

* Read "Lettres Provinciales," Blaise Pascal.

From the picture by G. Sheridan Knowles, R.I.

VICTIMS OF RELIGIOUS PERSECUTION.

Huguenots making their escape from France during the winter of 1685 after the Revocation of the Edict of Nantes.

From the painting by H. J. Vetter, in the Luxembourg.

MOLIÈRE DINING WITH LOUIS XIV.

The vagrant poet was viewed with disfavour by the courtiers at Versailles who refused to sit at table with him. The king, therefore (see Thackeray's *Paris Sketch Book*) condescended in the presence of his court to "put his Imperial legs under the same mahogany" as the poet.

terests of the Monarchy than to alienate two such powerful sections of the community.

Family bereavements almost without parallel filled up the old King's cup of sadness to overflowing. His brother Philip, who became Duke of Orleans on Gaston's death, died in 1701, and for the new Duke of Orleans, another Philip, a man of extremely brilliant parts, but of dissolute life, the King conceived ineradicable dislike, which grew much stronger as events unfolded themselves.

Family Bereavements

Louis' only legitimate son, the Dauphin, had been educated with exceptional care, a well-known edition of the Classics having been prepared for his behoof, but he grew up without much character or distinction. And *he* died in 1711. His eldest son, the Duke of Burgundy, now became the Dauphin.

He was in every way estimable, and the people's hopes were centred on him; but his amiable wife, a general favourite, died in 1712, and the Duke followed her in a few weeks. Of his two sons one died young and the other, the heir apparent, was a sickly infant of two, not expected to reach manhood. Dauphin Louis' second son, the Duke of Anjou, now occupied the Spanish throne, and had forsworn the French crown, and his third and last son, the Duke of Berry, almost certainly to be Regent and not improbably King, died also in 1714.

To Louis' dismay his odious nephew would become Regent, and he sought to avert this calamity by abuse of his prerogative. He had had two sons by the Marquise de Montespan, of whom one, the Duke of Maine, was Governor of Languedoc, and the other, the Count of Toulouse, was an admiral. By edict the King conferred upon both the rank of Princes of the Blood, to the not unnatural indignation of the nobles, who bitterly resented the insult. Louis went still farther, for in his will he appointed the Duke of Maine guardian and the Duke of Orleans president of the council of Regency. The King probably thought he had finally checkmated Orleans.

Death of Louis

It was almost his last considerable act, for he died at Versailles on September 1, 1715, in the odour of sanctity, no doubt, but also in the odour of treachery, for—slippery to the end—he was abetting a Stuart rising to expel the Hanoverian dynasty. Next day the Parliament of Paris—only too glad to taste the sweets of authority again—annulled the will and the profligate Duke of Orleans became Regent of France. J. A. M.

From a sketch by W. M. Thackeray in his "Paris Sketch Book."

THE KING; LOUIS; KING LOUIS.

Photos: S. Leonard Bastin.

HOW WIND AND WATER EFFECT POLLINATION.

1. Italian Eelwort, one of the few plants which rely upon water for the distribution of their pollen-bearing flowers. 2. Pollen-bearing catkins of the birch; the short processes pointing upwards are the female (seed-bearing) blossoms. 3. Wind pollinated plants develop a wasteful amount of pollen. This may be strikingly demonstrated by brushing a flowering branch of yew against a black cloth.

Continued from page 209.

SCIENCES:

Contributors:—ANTHROPOLOGY AND ETHNOLOGY (Sir H. H. Johnston, G.C.M.G., K.C.B.). ASTRONOMY (Arthur R. Hinks, M.A., F.R.S.). BOTANY (E. W. Edmunds, M.A., B.Sc.[Lond.]). CHEMISTRY (E. H. Tripp, Ph.D.). ELECTRICITY AND MAGNETISM (L. M. Parsons, M.Sc.[Lond.], D.I.C.). GEOLOGY AND MINERALOGY (Arthur Holmes, D.Sc.[Lond.], A.R.C.S., D.I.C., F.G.S.). METEOROLOGY (L. M. Parsons, M.Sc.[Lond.], D.I.C.). PHYSIOLOGY (Sir Malcolm Morris, K.C.V.O., and D. W. Carmalt-Jones, M.A., M.D.[Oxon.]). SOUND, LIGHT, AND HEAT (E. W. Edmunds, M.A., B.Sc.[Lond.]). ZOOLOGY (E. A. Bryant and Ashley G. Brown, F.Z.S.).

BOTANY.—XVII

48. The Gynœcium.—THE gynœcium, or pistil, is composed of individual parts called *carpels*. It may be *apocarpous*, when the carpels are completely separate; or *syncarpous*, when they are more or less fused into a single structure; or *monocarpous*, when there is only one carpel. The word "carpel" means "little fruit," and in many cases we can read the structure of the gynœcium in the fruit.

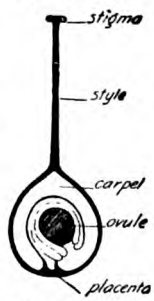


Fig. 115.—Diagram of Carpel, containing one ovule.

Taking the simplest case, we have the monocarpous pistil of such a flower as the pea. The stigma, style and ovary can be readily made out, as we have previously described. Examine the ovary more closely, and observe that it is really the pea pod in miniature. Along one edge is to be noticed a pronounced rib, the *dorsal suture;* along the other edge runs an equally pronounced groove, the *ventral suture*. It is to the inner edges of the latter that the ovules of the flower, and the seeds of the mature pod, are attached. The pea pod dehisces along either suture; but the pod of the larkspur or hellebore will dehisce along the ventral suture only.

The carpel is in reality a profoundly modified leaf, like the stamens. It is well known that the so-called double flowers set no seeds; and if they are examined the reason will be plain; the stamens, and sometimes even the carpels, have become petaloid; that is, they have returned to their leaf-like character. Now, a carpel is a leaf folded over on its midrib until its free edges meet and form the closed ovary. From these free edges develops the *placenta* on which the ovules are borne (Fig. 117). In the gymnosperms, which includes the members of the great pine family, the ovary is not thus closed; the ovules are borne on the flattened open scales of the familiar cones, and the leaf-like nature of these scales is in their early stages at least quite evident.

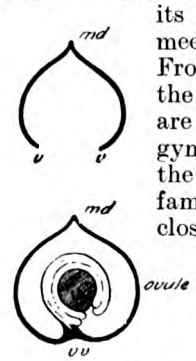


Fig. 116.—Diagram showing the formation of the ovary.

md: *Mid-rib of leaf = dorsal suture.* ***vv:*** *Free edges of leaf = ventral suture.*

The gynœcium consisting of a single carpel is not uncommon; but quite frequently we find a number of carpels, each of which is quite free from the rest, in one flower. This apocarpous pistil is well seen in the buttercup, clematis, larkspur, wild rose, etc. In this case the number of carpels can readily be counted.

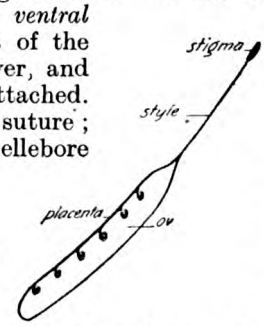


Fig. 117.—Diagram of carpel containing many ovules.

Each ovary may contain one or many ovules (Fig. 116). When there is only one ovule, it is usually attached to the base, rarely to the apex, of the ovary. Under the lens, the ovule is seen to be an oval structure attached to the placenta by a short stalk. It has two coverings called the integuments, which are pierced by the micropyle. In most cases the ovule does not grow erect

on its stalk, but through the fuller development of one side the micropyle is brought to face the placenta as shown diagrammatically in Fig. 118.

In the syncarpous ovaries, the constituent carpels are more or less united together. Sometimes the union extends to the styles and stigmas also; but generally the stigmas remain free, and thus enable us to tell at a glance how many carpels have gone to the formation of the pistil. The styles also remain free in some cases, such as the campions, saxifrages, St. John's wort, etc.; more often they unite to form one single style.

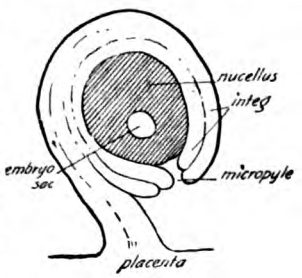


Fig. 118.—Diagram of ovule.

The united ovary may contain one cavity (*unilocular*), or many (*multilocular; bilocular, trilocular*, etc.). In the unilocular ovary, the union has been formed before the free edges of the individual carpels have met one another; the edges of neighbouring carpels join, and form a placenta at their point of junction. The placentas thus run along the walls of the ovary, and are called *parietal;* evidently the number of placentas is the same as the number of carpels, and this can easily be found by cutting the ovary transversely. The pansy is a good example of this arrangement; it has a unilocular ovary with three parietal placentas, and hence it has three carpels in each flower (Fig. 119).

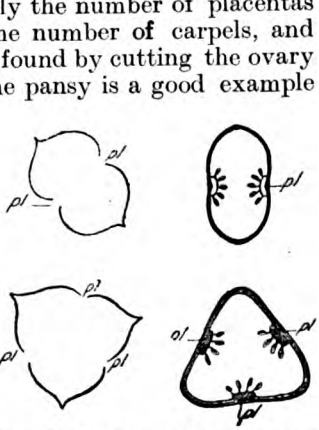


Fig. 119.—Formation of unilocular ovary.
pl = (*parietal*) *placenta.*

When the ovary has several chambers or loculi, the carpels have first been completely formed, and then fused together in a whorl with the placentas at the centre. The placentation is then described as *axile*, and the number of loculi indicates also the number of carpels. Apparent exceptions to this are due to the later development of new partitions or septa, and will be mentioned again when dealing with the special families in which they occur (Fig. 121).

The pistil of the primrose and a few other plants offers special difficulties in determining the number of carpels. The stigma is knob-like and shows no sign of division. The ovary again is unilocular, and the placentation is *free central*, the ovules being borne on what looks like a special axis developed from the base of the ovary. It is not possible, therefore, to count the carpels in the flower itself. But when the ovary has ripened into fruit it dehisces from above by means of *five* valves, which correspond to the original joints where the carpels were united.

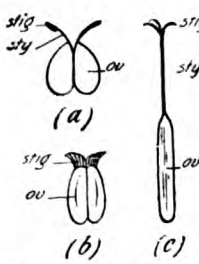
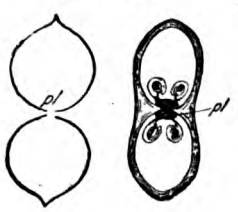


Fig. 120.—Pistils of
(*a*) Saxifrage;
(*b*) Carraway;
(*c*) Daffodil.

DEMONSTRATION XXXIII

The examination of the carpels is the most important part of floral observation, especially when the desire is to classify the plant. The student is therefore strongly recommended to examine carefully the carpels of a fair number of mature flowers, and to answer *all* the following questions on them. A lens is usually necessary in the case of small flowers.

1. Number of Carpels. Syncarpous or Apocarpous?
2. How is the number of carpels recognised?
3. *Stigma:* Number? Nature?
4. *Style:* Number? Short or Long?
5. *Ovary:*
   Shape—Can you gather anything from this?
   Position—Superior or Inferior?
   Loculi—1, 2, 3, 4 or ∞.
   Placentation — Axile, Parietal or Free Central?
   Ovules—Number?
6. Draw diagrams representing (*a*) External appearance; (*b*) Cross Section; (*c*) Longitudinal Section.



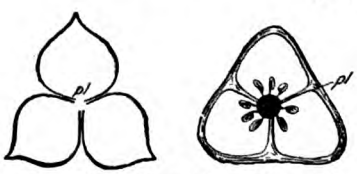


Fig. 121.—Formation of multilocular ovary.
pl = (*axile*) *placenta.*

49. Fertilisation.—The function of the flower is to produce seeds containing embryo plants, and for this purpose two parts of the flower are alone essential—the ovules and the pollen grains. It is the ovule that changes into a seed, but it will not produce a fertile seed unless it undergoes a process called fertilisation, for which process a pollen grain is indispensable. The pollen may

come from the same flower or from another of the same species. The latter is the more usual, though self-fertilisation occurs in very many flowers. But all the more handsome and healthy plants are cross-fertilised, the result of self-fertilisation or in-breeding being a plant less strong and less conspicuous. The necessity of the pollen can easily be shown by clipping off the anthers from a flower before they are ripe, and then enclosing the whole flower in a muslin bag. No seeds will then be produced. But if the stigma is brushed with the pollen from another specimen, seeds will be produced. By this latter means, the comparative values of self- and cross-fertilisation can also be studied.

When a pollen grain falls on the stigma of a flower, it will, if the two belong to the same species, proceed to put forth a slender tube, the *pollen tube*, which continues to grow down the style and along the wall of the ovary until it finds the micropyle of an ovule (Fig. 122). This it enters, and a portion of its contents enters the ovule and fertilises it. Inside the ovular integuments is a mass of cells called the *nucellus*, embedded in which is an especially large cell, the *embryo sac*. It is in this cell that the actual fertilisation takes place. Here are ultimately formed the embryo and the endosperm (if any). The food store is in any case supplied by the nucellus which gradually becomes obliterated as the embryo sac increases. The final result is the seed, in which the two coverings (testa and tegmen) correspond to the integuments of the ovule, and the embryo and food-store to the much-enlarged embryo sac. The micropyle remains also, and it will be remembered that the attachment to the placenta is permanently marked by the hilum of the seed.

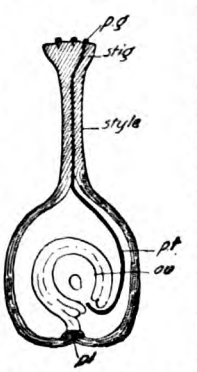


Fig. 122.—Fertilisation of ovule.
pl = *pollen tube.*

50. Pollination.—The process by which pollen is brought on to the stigma is known as pollination, and it is the function of a flower to bring this about. As we have hinted in our previous section, some flowers are self-pollinated, though most are cross-pollinated. In theory, most flowers should be capable of self-pollination, seeing that they contain both stamens and carpels, *i.e.* are *hermaphrodite*. But the advantages of cross-pollination are so great that most hermaphrodite flowers have developed definite arrangements to avoid the inferior method. In some cases, for example, the relative position of the anthers and the stigma make it improbable that the light pollen will find its way from the one to the other. In other cases, the two organs, though they occur in the same flower, are not mature at the same time. This is very noticeable in the willow-herb and Canterbury bell, where it is quite evident that the stigmas are not expanded when the anthers are ripe, and that the anthers are dead when the stigma is open. Such flowers are described as *protandrous*. The opposite state of things occurs in figwort, salad burnet and plantain; it is much rarer, however, to find *protogynous* flowers than protandrous ones. When either condition exists in its extreme form, self-pollination is clearly impossible; but it does not always exist so definitely as in the examples mentioned. Some flowers, while normally hermaphrodite, sometimes contain stamens or carpels, but not both. Thus on the white campion we may find that all the flowers are normal, or that flowers which bear stamens only are the rule (male flowers, ♂), or that flowers bearing carpels only are formed (female flowers, ♀). Only one kind is found on any one plant; but a single ash tree may produce flowers of all three kinds. In these cases we may perhaps regard the imperfect flowers as extreme examples of protandry or protogyny, in which the carpels or stamens as the case may be have not had time to develop.

The formation of stamens and carpels in separate flowers is the rule in a large number of flowers which are never hermaphrodite. The staminate or male flowers (♂) may be borne on the same plant as the pistillate or female flowers (♀), when the plant is described as *monœcious* (e.g. hazel, oak, beech); or the male and female flowers are always formed on separate plants (as in willow, poplars, nettle) when the plant is *diœcious*. Of course, self-pollination is impossible in these cases.

Self-pollinated flowers are usually small and insignificant, and the plants to which they belong are also small and weedy. Since pollination is sure to occur, such plants are very prolific; the shepherd's purse, for example, produces an abundance of seeds which will often develop to the third generation in one season. Some flowers which are well adapted to cross-pollination may nevertheless be self-pollinated as an emergency measure. The anthers deposit their pollen on the style and the stigma curls backward

to pick it up; this occurs in many flowers of the daisy family (Compositæ). Sweet peas are, under cultivation, as often self-pollinated as not. The violet too, if the normal cross-pollination fails, produces what are known as *cleistogamous* flowers, which never truly open; they appear as little buds, and the anthers shed their pollen direct on to the stigma.

Cross-pollination is effected either by the wind or by insects, very occasionally by water. Flowers which are pollinated by the wind are termed *anemophilous*.

DEMONSTRATION XXXIV

1. Examine in March the *catkins* of the hazel which are familiar objects in the hedgerows and copses of England. The male catkins are long and drooping, and arise in clusters of two or three, or singly, from a short branch. Each catkin is composed of a succession of scales, from the axils of which proceed four stamens, so that the whole catkin contains a large number of stamens which, when ripe, liberate their pollen on the slightest motion. The female catkins are small and bud-like; when mature they can easily be recognised by the tuft of red stigmas which protrude from them.

2. Towards the end of May the male *cones* of the pine are to be observed. These will be found in conspicuous yellow clusters near to the new leaves. Each cone consists of a large number of scales, which produce their pollen in pollen sacs on their underside. The female cones are much less numerous; they are found singly on the same tree but not on the same branch as the male. They also consist of a number of scales which open during the pollinating period, but close again after pollination, and remain on the tree for more than a year, enlarging and becoming woody till the seeds are formed, when they again open and liberate the seeds. The larch is another cone-bearing tree which repays study; its fresh female cones are to be looked for in early spring, and can be recognised by their beautiful purple tint.

3. The dog's mercury is an abundant weed in woods and hedgerows, and flowers quite early. It is dicœcious, but the male and female plants are never far apart, since the habit of the plant is to grow in large colonies. Both male and female flowers are very small. Their perianth consists of three scales, which open and disclose the stamens or carpels as the case may be.

4. Towards the end of June, most of our grasses are in flower. Again the individual flowers are small, but occur in close clusters, familiar to us in our ears of wheat, oats and barley. Each flower has three stamens which hang out loosely and droop owing to the weight of the comparatively large anthers. The two stigmas are feathery, and well adapted to the collection of the pollen blown in their direction from neighbouring grasses. The flowers occur in little groups or *spikelets* which are covered by two chaffy scales called *glumes;* each flower has two subsidiary scales called *paleæ.* The whole inflorescence is made up of these spikelets, which may be loose or compact. E. W. E.

GEOLOGY.—IV

Denudation and Climatic Regions.—The agents of denudation are—

(*a*) Air and wind.
(*b*) Frost and thaw, and other alternations of temperature.
(*c*) Rain and rivers.
(*d*) Snow and ice (glaciers).
(*e*) Tides, waves, and ocean currents.
(*f*) Living organisms.
(*g*) Gravity.

It will be clear from this list that in any district the nature and extent of denudation must be dependent on climatic conditions. Four main types of denudation can be recognised on this basis according as the climate is—

(1) Equatorial, with hot and damp conditions.
(2) Desert or arid, with hot and dry conditions.
(3) Temperate, with cool and damp conditions.
(4) Arctic, with cool and dry conditions.

In *equatorial* regions chemical and organic decay of the rocks is the predominant feature. In *desert* regions, rainfall is low, vegetation is rare or absent; temperature changes are extreme. Wind, armed with a blast of sand, is the chief agent of erosion and transport. In *temperate* regions all the agents of denudation are at work. In *Arctic* regions frost action breaks up the rocks, and glaciers and ice-sheets carry away the debris. Chemical and organic decay is at a minimum.

The Chemical Work of Air and Rain.—The atmosphere consists of a mechanical mixture of oxygen and nitrogen in approximately the proportion of 1 to 4 by volume, accompanied by small quantities of water vapour and carbon dioxide, and still smaller amounts of ammonia, ozone, and the rare gases of which argon is the chief member. The work of air is (1) *chemical* in virtue of its oxygen, carbon dioxide, and water vapour, though the latter becomes a more powerful weathering agent when it is precipitated as rain; (2) *mechanical* in the form of wind; and (3) *physical*, owing to temperature changes. The work of rain is chemical, especially since it acts as a carrier for the atmospheric gases which it dissolves, and since it is able to penetrate far into the interstices of the rocks; it is mechanical because it washes away loose particles from their original position down to lower levels. Here we may also mention the work of organisms. Boring

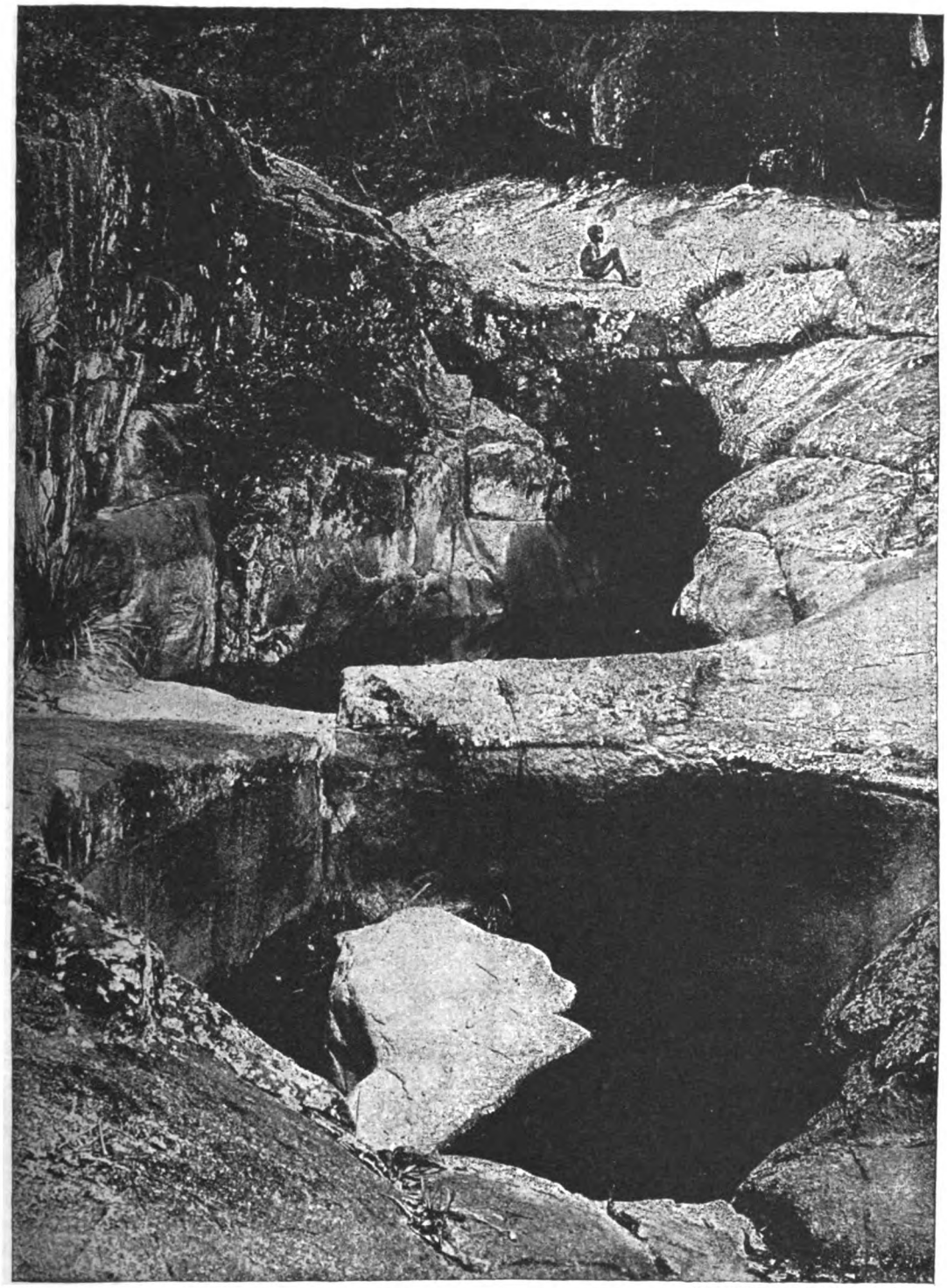
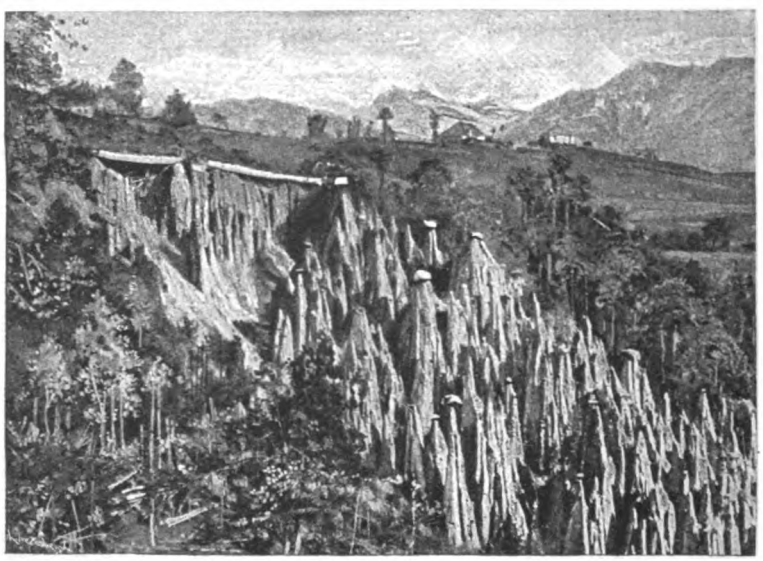


Photo: by permission of the Agent General for Queensland.

POT HOLES NEAR CAIRNS IN QUEENSLAND.

Pot holes are found in rocky river beds—usually below rapids, where boulders and gravel have been rapidly swirled round by eddies (*see* p. 330).

animals, such as worms, pass through the soil, and the roots of plants work their way through the underlying rocks, thus preparing the road for further decay. By their death and decomposition, organisms provide an additional store of carbon dioxide, and vegetable matter gives rise to a number of obscure *humus* acids. These products are dissolved by percolating waters, which are thus enabled to act more energetically as agents of chemical decay.



EARTH PILLARS IN THE RITTNERHORN, SWITZERLAND.

Pillars such as these may be seen sometimes on a small scale in ploughed fields, and afford convincing proof of the mechanical work of rain. A pebble or boulder will act like an umbrella protecting the soil under it while the soil around is washed away, leaving a stone-capped and more or less cone-shaped pillar.

When the surface rocks are acted on by rainwater, carrying oxygen and carbon dioxide in solution, three kinds of changes take place. Elements like sodium and potassium are readily dissolved as *carbonates*. Elements like calcium, magnesium, and iron in the ferrous state are dissolved as bicarbonates—that is, the carbonates are soluble in water which contains an additional store of carbon dioxide. While these changes are going on, the residual substances—e.g. aluminium silicates—are *hydrated* to form the clay-minerals, kaolin and halloysite. *Oxidation* also takes place near the surface, and ferrous oxide, which is a common constituent of the dark minerals of igneous rocks, becomes oxidised and hydrated to limonite, $2Fe_2O_3.3H_2O$. It is to this that the rusty brown colour of weathered rock surfaces is due. Sulphides, such as pyrite, are also oxidised, and pass into solution as sulphates.

In these ways igneous rocks lose their cohesion and are disintegrated, limestones and the calcareous cements of sandstones are dissolved away, joints in these rocks are widened, and since solution acts most readily on sharp edges, rounded surfaces are characteristically produced.

The Mechanical Work of Air—Wind.—When air is in motion as wind it is able to carry before it fragments of dust and sand which have been loosened from the rocks by decomposition and disintegration. Sand dunes are frequently piled up along the sea coast, where the beach sands have been carried inland by wind, and then caught and fixed by vegetation. Cross bedding and ripple marks are characteristic structures. Sand dunes may obstruct the natural drainage of the land, and a river may thus be diverted from its original course. More frequently long lines of shallow lagoons running parallel with the coast collect behind the dunes.

Along the coast sand dunes are not rapidly removed by the wind if the vegetation is sufficiently strong to hold it. In some places, however, as in Elginshire, extensive forests of fir trees have been buried and destroyed by the inland advance of wind-blown sands. In deserts, sand hills are not arrested by vegetation, and they are moved from place to place according to the direction and strength of the winds.

When armed with a blast of sand, wind becomes a powerful cutting agent, and it is thus enabled to groove and furrow the faces of outstanding masses of rock and to wear them into fantastic shapes according to the varying hardness of different beds. Undercutting is frequently seen, and mushroom-shaped rocks result.

The Physical Action of Air—Temperature Changes.—In arid regions and in the interior of continents there is

often a daily range of temperature of 40° or 50° F. During the day the surface layers of the rocks are heated, and expansion follows; during the night they are cooled, and contraction follows. The immense stresses set up by alternate expansion and contraction are responsible for the phenomenon known as *exfoliation*, in which thin superficial shells of rock break away from the underlying mass. In the tropics chemical decay is also in progress, and the net result of the two processes on hills and mountains is to develop rounded domes and peaks. In Central Africa high precipitous domes stand out like islands above the densely wooded plateaus, and the surfaces of these *inselberge*, as they are called, are gradually reduced by the peeling away of successive rounded shells and flakes of rocks.

The action of frost and thaw in shattering the rocks, leaving jagged ridges above and providing the materials for angular screes below, is a remarkable phenomenon.

The Mechanical Work of Rain.—The principal mechanical effect of rain as it pelts down on the decomposed rocks is to loosen the particles and carry them down to lower levels. Sooner or later they find their way into small rills and streams, and the work is carried on by the rivers. Perhaps the most convincing proof of the work of rain is afforded by the peculiar structures known as earth-pillars. In ploughed fields and unpaved roads these may sometimes be seen on a small scale. A pebble or boulder acts like an umbrella, protecting the soil or loam beneath it, but all around, the soil is washed away, and a small pillar, more or less cone-shaped and with a stony cap on top, remains as a witness to what has happened. In boulder clay, where the protecting boulders may be a foot or more across, and where the action of rain continues without interruption year after year, earth pillars 20 feet or 25 feet in height may be formed.

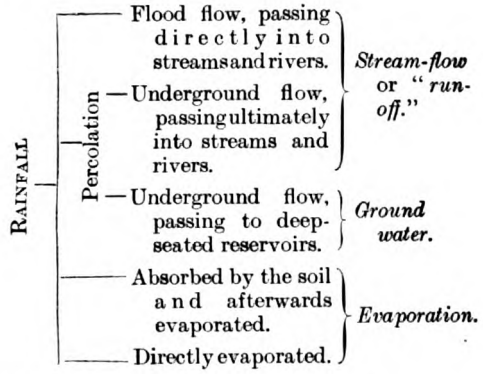
The earth pillars of the Tyrol are the most famous, but they occur also in Scotland, and in other glaciated regions where boulder clay has been deposited.

The Circulation of Rainfall. — The water which falls on the land as rain does not all follow the same course. Part flows straight away over the land, and is called the flood-flow. Part percolates into the ground, and of this some passes laterally into streams and some sinks far down into natural reservoirs, to feed and maintain the permanent *ground* waters. Part is absorbed by the soil for a time, and is then evaporated, largely by being drawn through vegetation to the surfaces of leaves, but to some extent by direct evaporation. A fourth part of the rainfall is directly evaporated from the surface of whatever it happens to have

AN EXAMPLE OF EXFOLIATION,

that is to say the breaking away of superficial shells of rocks as a result of the immense stresses set up by the alternate expansion and contraction of rocks due to fluctuations in their temperature.

fallen on. The natural history of rain-water may be expressed as follows :—



Springs.—Rocks through which water can readily pass are said to be *pervious.*

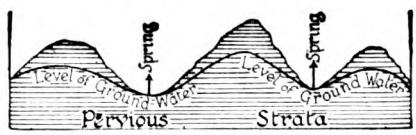


Fig. 28.—Rocks through which water can readily pass are said to be pervious. Below a certain level all rocks may be permanently saturated to a considerable depth.

Such rocks are porous, and the porosity evidently depends on the shape and size of the constituents and on the cement which binds them together. Sand and chalk, for example, can hold on the average 2 gallons of water per cubic foot (Fig. 28).

Impervious rocks are those through which water cannot easily penetrate, such as clays, shales and slates, and granite, and

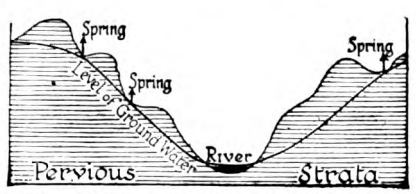


Fig. 29.—If the saturation level rises, intermittent springs (or floods) occur.

other igneous rocks. In these, however, water may circulate through cracks, joints, fissures, etc.

Below a certain level all rocks may be permanently saturated, and the level of this ground water is called the water-table or saturation level. If for any reason—e.g. excessive rainfall—the saturation level rises above the level of the ground, floods occur, or intermittent springs appear (Figs. 29, 30).

Intermittent springs, then, may arise after heavy rainfall, when the water level has risen. Conversely, they will die away during

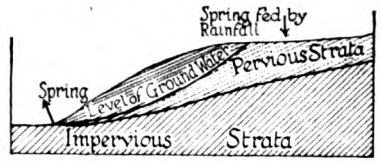


Fig. 30.—Intermittent springs may arise after heavy rainfall.

dry weather, as soon as the water level has fallen.

Another class of spring depends on the holding up of water by impervious strata—

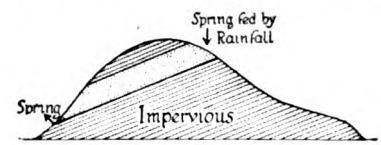


Fig. 31.—When rain water falls into pervious beds it sinks until it meets an underlying impervious bed. Wherever this bed comes to the surface a spring will be formed.

e.g. of clay. When rain-water falls into pervious beds it sinks till it reaches an underlying impervious bed. It will then flow

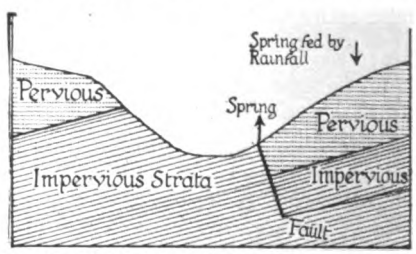


Fig. 32.—Springs may be formed at the junction of pervious and impervious beds, due to the presence of a fault—

along the surface of the latter, and if this bed comes to the surface at any place, a spring will be formed at the junction of the

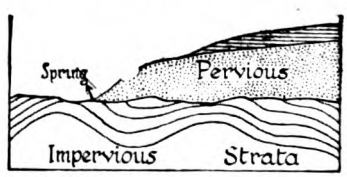


Fig. 33.—or due to an unconformity.

pervious and impervious beds. The junction may, of course, be due to the presence of pervious and impervious beds in a con-

formable sequence, or to an unconformity, with impervious beds below, or to a fault which may bring a pervious bed against an impervious one.

Artesian Wells.—The springs so far considered are all part of the "run off." The accumulated ground water in deep-seated beds is far more valuable as a source of water supply, since it is free from surface contamination. A shallow syncline or basin with a pervious bed of chalk or sandstone underlain by clay, and preferably also overlain by clay, is the best structure for ensuring

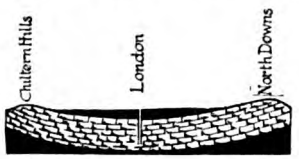


Fig. 34.—A basin with a pervious bed of chalk (e.g. the London basin) is an excellent structure for ensuring a pure water supply.

a pure water supply. The London Basin illustrates these conditions in an ideal form.

To the north the chalk outcrops in the Chiltern Hills, passes under the London clay to the south in a basin-like form, and rises up to the surface again in the North Downs. Below are the clays and marls known as the Gault. Water falling on the outcrops along the Chilterns and the North Downs sinks down into the basin, and there accumulates. If, then, the London clay is penetrated by a boring, the water in the chalk is tapped, and under the pressure of water at higher levels around the rim of the basin, it rises up and may even be forced above the level of the ground, so that no pumping is necessary. Such a well is called an *artesian well*. In the case of the chalk, much of the water has already been abstracted; but by boring below the Gault another water-bearing stratum—the Lower Greensand—is reached. This formation outcrops in Leith Hill and the other eminences of the "Ragstone Range" in Surrey and Kent, and is underlain by the Weald clays.

The Work of Rivers. — Rivers act as agents of *erosion* both chemically and mechanically, since they dissolve away certain constituents of the rocks with which they come into contact, and when charged with sediment they wear away and deepen their beds. This process of abrasion and excavation, which also implies the *transport* of loosened debris, is sometimes termed *corrosion* or *corrasion*. The erosion and transport which a river is capable of performing depends on three main factors—

(1) The gradient and rate of flow.

(2) The character of the transported debris.

(3) The nature and structures of the rocks through which the bed is cut.

When the flow is rapid a stream is able to carry more debris of any given size than when it is slow. The transporting power is not directly proportional to the velocity, but increases much more rapidly, being proportional on the average to the third or fourth power of the velocity. Consequently, during floods heavy boulders may be moved which, under normal flow, would be immovable. Moreover, the grinding away and excavation of the river bed, which means both deepening and widening, takes place much more effectively during floods than at any other time. Heavy debris which normally would cover up parts of the bed is removed, scraping away the newly exposed floor as it travels down stream.

Streams carry debris partly by *rolling* along the bed—the bottom load—partly by *saltation*, in which the sand or gravel moves along in a series of leaps, and partly in more or less permanent *suspension*—the suspended load. If the velocity falls, part of the load is deposited; if the velocity rises, the load is increased, and corrosion becomes more active.

Fine suspended particles have little power of corrosion, but sands moving by saltation, and gravels and boulders rolled along the floor, effect most of the scraping which gradually lowers and widens the channel.

The Curve of Erosion.—In the upper part of a typical river erosion is, relative

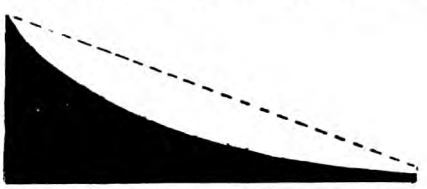


Fig. 35.—River erosion is relative to the volume of water, and river beds tend towards a smooth curve from sea level to source.

to the volume of water, at a maximum, for the gradients are steeper than elsewhere, and the outlines of the surrounding hills are frequently steep and rugged. This is the *torrent* tract. Lower down, in the middle portion of the stream—the *valley* tract—erosion is less rapid, deposition begins to take place where the slopes are gentle and corrosion where they are steeper. Nearer the sea, in the *plain* tract, the valley is broad and wide, erosion is feeble, and

deposition is at a maximum. Consequently, the river bed tends towards a smooth curve from sea level up to the source. Ultimately, as the river continues its work, the plain tract is extended upstream at the expense of the valley tract, which in turn develops upstream at the expense of the torrent tract. The latter eats back into the watershed, which is thus slowly worn down. If the volume of water were the same from source to sea, the river bed would become a nearly horizontal plane. Since, however, the volume of water is less and less as the head is approached, the river bed tends to a concave form, the section of which is spoken of as the curve of river erosion.

Gorges and Waterfalls.—A valley is always carved out along the line of least

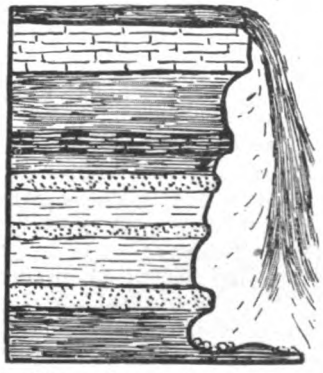


Fig. 36.—Waterfalls occur where a stream passes across a series of alternating hard and soft rocks. Ultimately a hard band forms a cornice over which the water falls.

resistance. Soft and soluble rocks are followed rather than hard and insoluble ; fractured rocks rather than compact and indurated rocks ; joints and fissures, faults and subsidences due to earth movement are chosen in preference to lines along which new channels would require to be cut. In soft and easily eroded formations the river channel tends to be wide and shallow. In hard rocks, on the contrary, the channel tends to be deep and narrow.

A *gorge* is a deep valley with steep sides and is due to the action of a swift stream which can deepen its bed more rapidly than the other agents of denudation—e.g. rain and frost—can wear back the valley walls.

A *cañon* is a narrow gorge of great depth in proportion to its width. The celebrated Grand Cañon of Colorado is a magnificent example of river erosion. There the Colorado River has cut a steep-walled trench, in places over a mile deep. The climatic conditions are arid, and local rainfall is low. The river has cut vertically downwards, while the desert plateau has been slowly elevated by the heaving of the earth. Except near the surface, the weathering agents have been incompetent to widen the gorge.

Waterfalls are found in the course of a stream where the latter passes across a series of alternating hard and soft rocks (Fig. 36). The softer rocks are removed more easily and therefore more rapidly than a hard resistant formation. Ultimately a hard band forms a cornice over which the water falls.

In a cataract or rapid the slope is comparatively low ; a cascade is a steep but not a vertical descent ; and in a waterfall the drop is actually vertical. When the strata are not steeply inclined the hard band is gradually worn back edgewise, partly by crumbling owing to undercutting of the soft beds below, and partly by direct erosion. In this way a waterfall gradually recedes from its original position, and the gorge in front of it extends up stream. The Niagara Falls have receded about seven miles in this way, and are now being worn back about 4 feet every year.

Pot holes are sometimes found in rocky river beds, and particularly below rapids and waterfalls, where boulders and gravel have been rapidly swirled round by eddies. Cauldron-like holes are thus developed, and once begun, the boulders are not easily

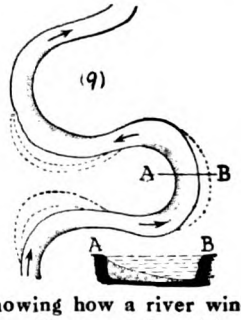


Fig. 37.—Showing how a river winds. Section A–B illustrates deposition.

carried away, and the pot holes are gradually deepened and widened.

The Winding of Rivers.—In the torrent tract, a river tends to pursue as straight a course as possible, but in the lower course, where the rate of flow is much reduced, the stream is readily turned by any obstacle, and it begins to bend in various directions. Once a bend has begun, the main current is always towards the concave side, which is consequently corroded. On the opposite—convex—side the velocity

is checked, and deposition of the load of sediment takes place. Thus the bend is gradually widened and sharpened until a loop is formed. In the course of time the ends of the loop nearly touch, until at last a flood succeeds in breaking through, and the old round-about course is deserted for a short cut across the narrow neck. The abandoned channel may then become the site of a crescent-shaped lake—e.g. the *Ox-Bow* lakes of the Mississippi.

Deltas and Estuaries.—When a river reaches the sea, its load of sediment is deposited, because the river current is suddenly checked. Tides and ocean currents, however, may be sufficiently strong to sweep away the material and so prevent the river mouth being completely silted up. If in addition the land and adjacent sea floor are slowly sinking, the valley will be partly submerged, and the depth of water at the mouth will be maintained. Estuaries are the tidal portions of rivers having only a single outlet to the sea, and their development is favoured by strong tides and currents and by earth movements of a downward type.

When tides and currents are weak the river mouth tends to be silted up. Deposition will be greatest where the load carried is greatest; that is, about the central portion of the river where the current is strongest. A bank is thus formed and sand and gravel are rolled along its surface and tipped over its seaward edge. The bank thus grows seawards like a railway embankment. Sooner or later the bank reaches the surface and the river divides and flows to each side. By a repetition of this process each branch builds up a central bank of sand and mud and divides again. In this way a fan-shaped series of deposits grows seawards with the branching channels of the river between. The formation of a delta is favoured in addition by a rise of the land and of the adjacent sea floor, for in this way the deposits of gravel, sand, and mud may be raised above sea level.

Fig. 38.—To illustrate the formation of a delta.

Rate of Denudation. — It will be clear that the final result of denudation is to wear away and lower the land surfaces. Is it possible to determine the rate at which the lands are being worn down? Four factors are necessary—

(1) The annual discharge of rivers into the sea.

(2) Measurements of the "load" of detritus.

(3) Chemical analyses of their waters.

(4) The area of the river basins.

For many river basins these factors are fairly well known. The following table summarises our knowledge of the rate at which material is removed by solution:—

Continent	*Drainage area in square miles*	*Tons of material removed in solution per year*
N. America ..	6,000,000	423,000,000
S. America ..	4,000,000	182,000,000
Europe	3,000,000	270,000,000
Asia	7,000,000	525,000,000
Africa	8,000,000	320,000,000
Totals ..	28,000,000	1,720,000,000

Measurements of the mechanical load of rivers show that in general this amounts to between two and three times as much as load carried in solution. For *all* the drainage areas of the world —about 40 million square miles—the amount of material annually removed and carried to the seas is found to reach (in round figures) the enormous total of 8,500,000,000 tons. This figure includes the material removed in solution and that removed mechanically in the following proportion:—

	Tons
Material annually removed in solution	2,500,000,000
Material annually removed mechanically . . .	6,000,000,000
Total	8,500,000,000

These figures imply that solvent or chemical denudation wears down the land at the average rate of 1 foot in 30,000 years; mechanical denudation at the average rate of 1 foot in 12,000 years. Taking both together, as they actually are, the average rate of denudation is found to be 1 foot in 8,600 years. The application of these figures to the study of the deposition of sandstones and shales and limestones provides an interesting study. A. H.

ANATOMY AND PHYSIOLOGY. XII

HAVING seen how the blood is circulated, and how it obtains oxygen in the lungs and loses it in the tissues, and also gains carbon dioxide in the tissues and loses it in the lungs, we have next to find out how the blood receives the food, which serves for fuel in the body machine.

The blood receives food from the stomach and intestines, which go to form the *digestive system*, and the food is put into the digestive system from the outside world.

The digestion has to be studied from three points of view :

(1) What happens to the food in a mechanical way; how is it passed through the alimentary tract ?

(2) What is food ? What is the chemical composition of food, and how is this composition changed by digestion ?

(3) When the food has been absorbed into the blood, how is it used by the body ?

The Mechanics of Digestion

The food is first taken into the mouth. Some food is hard, like the crust of bread; some food is tough, like beefsteak. Since the gastric juice and the secretions of the digestive glands have to reach every part of it, it has to be broken up into very small pieces. This is done by the teeth. In the mouth it is well mixed with saliva, or spittle, which helps to make it into a paste which is easily swallowed. In addition, the saliva helps to dissolve some parts of the food.

When the chewing up in the mouth is finished, the food is swallowed. It is pushed back by the tongue into the pharynx, while the larynx is drawn forward and upward, so that food does not pass into the lungs. The pharynx is a muscular tube which can be made to contract at will, and this pushes the food down into the alimentary tract proper, the part of the body which only has to deal with food, and with nothing else.

We have seen that the heart muscle has the peculiar power of rhythmical contraction, which it keeps up all life long : also that there is a regular contraction and relaxation of the breathing muscles depending on the presence of carbon dioxide in the blood. The intestines also have their peculiar kind of muscular contraction. The digestive tract proper consists partly of a muscular tube, made up of plain, unstriped, involuntary muscle. Its peculiarity is that its fibres contract in such a way that they force the contents of the tube along it, always in the same direction, from top to bottom.

Take a piece of rubber tube, like a garden hose. Fix one end of it, and grasp the tube in your hand. Now pass this hand down the tube, with a "milking" motion, you will force along any liquid there may be in the tube. You will produce the same effect if you grasp the tube firmly with your left hand, and then put your right hand up alongside of the left and squeeze with that, and then put your left hand on beyond your right again.

This is very much like what happens in the digestive tract ; it begins to contract at its upper part, then the part next to that contracts, and then the next farther down, so that the contents are always being passed on. This power of successive contraction of the different parts of the tube is called *peristalsis*. It occurs in involuntary muscle, and is quite independent of the will; you cannot by any effort of your own make your intestines contract as you can make your biceps or the muscles of your pharynx contract, but while there is food in your intestines the muscle is continually contracting on it and passing it along.

The Food Clearing House

As soon as the food is forced from the pharynx into the œsophagus, the œsophagus starts peristalsis and the food is passed rapidly through the chest into the stomach. There are no digestive organs in the chest, it is given up to the heart and lungs, and the food is passed through it as quickly as possible.

Having passed through the chest, the digestive tract expands at once into a large bag, the stomach, in which the food has to stay a considerable time. The lower end of the œsophagus is kept tightly closed except when food is actually passing down, and so seals up the entrance to the stomach, and prevents food going backwards. The ring of muscle at the entrance to the stomach is called the *cardiac sphincter*, which means "the grasp at the heart end of the stomach." The other end of the stomach is closed by another sphincter, the *pylorus* or *pyloric sphincter*. The stomach itself is a large muscular bag, and its contractions turn the food over and over and round and round, in what are called "churning movements," while the process of digestion of the food goes on.

After about half an hour the pylorus opens and a little of the contents of the stomach passes into the duodenum, which is the upper end of the small intestine. The

food only leaves the stomach a little at a time, and the organ is not emptied for several hours.

The food passes down the small intestine by peristalsis, but is checked for a time at its lower end. Here there is another sphincter, which, with some folds of mucous membrane, forms the *ileo-cæcal valve.*

The small intestine is divided into three parts, the upper part about twelve inches long, called the duodenum, a part consisting of about half the remainder called the jejunum, and the lower part called the ileum. It is all the same tube, the same waves of peristalsis pass down its whole length and the same process of digestion occurs in it.

The food passes at intervals into the large intestine through the ileo-cæcal valve. The contractions of the large intestine are less frequent than those of the small, and do not continue right on to its end, so that the contents become collected at its lower end. In the large intestine there is not so much digestion as *absorption;* the useful parts of the food have been dissolved higher up, and here they are taken up by the blood vessels dissolved in water. The result is that the contents of the bowel become more and more dry, and take on the shape and consistence in which they are expelled from the body as dung.

The technical name for this material is *fæces*, and the process of opening the bowels is called defæcation. This is an act over which we have a good deal of control; the fæces are not continually driven out of the intestine by peristalsis, but are only got rid of at intervals, generally once a day.

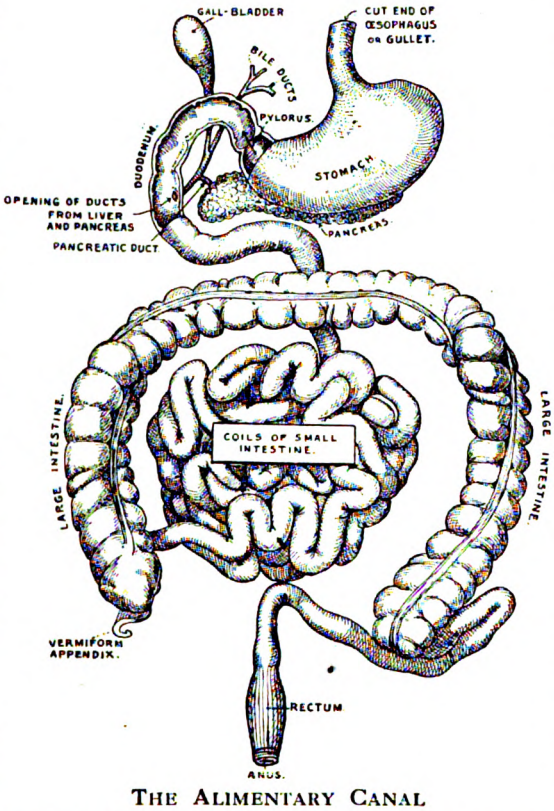
The large intestine consists of several parts—the ascending colon, the transverse colon, the descending colon, the sigmoid flexure, and the rectum. The arrangement will be more fully described later.

The sigmoid flexure is in the lower left-hand corner of the abdomen, and it is here that the fæces lodge. The lower end of the rectum is closed by a broad ring of muscle, the anal sphincter.

The fæces are driven out by raising the pressure in the abdomen, just as paint is squeezed out of a tube. One takes a deep breath and holds it; this keeps the diaphragm firm, and this is the roof of the abdomen; the abdominal muscles are then contracted so as to press on the intestines, at the same time the anal sphincter is slackened, and the fæces are forced out of the back passage, or anus. This is the whole course of the food from one end of the body to the other.

The stomach and intestines form a tube which is a great deal longer than the abdominal cavity in which they lie. They are, therefore, much coiled. If you had a long hose-pipe in a cupboard with one end fixed to the ceiling, and the other end to the floor, most of the pipe would collect on the floor, and if it were a thin pipe it would be crushed flat. This does not happen in the abdomen; the intestines do not all collect in the pelvis, because they are fixed up to the back wall by the *peritoneum.* The peritoneum is a serous membrane like the pleura and pericardium. It is a bag which lines the abdomen and also covers the stomach and intestines, and forms a sort of sling by which the intestine is moored to the back of the abdomen.

Its arrangement is very complicated. It is a bag, just as the pleura is a bag, and it can be understood as follows: Suppose the intestine were a short tube entering the abdomen through the diaphragm and run-



THE ALIMENTARY CANAL

into which food is quickly received when the process of chewing up in the mouth is finished, and through which it slowly passes (*cf.* p. 335).

ning straight down to the anus, and that the bag of the peritoneum were spread over it. Then if you cut the body in two across the middle you would see the peritoneum folded as in the diagram on p. 336. Then if the intestine grew longer it would bulge forward and draw the peritoneum after it in a fold, which would moor the intestine to the back of the abdomen.

The actual arrangement of the peritoneum is much like this. The chief fold is called the *mesentery*, and it runs from near the top left-hand corner of the abdomen to near the bottom right-hand corner. It forms a fan-shaped fold much narrower where it rises from the back of the abdomen than where it is wrapped round the intestine. In this way the intestine is free to move a good deal, when different parts of it are full, but it is prevented from collecting in a heap in the pelvis. The smooth surface allows the intestine to move without friction.

The Chemistry of Digestion

Digesting food means the dissolving of those parts of it which are useful as fuel, and so making them fit to be absorbed into the blood. What articles constitute food? All human food must be either animal or vegetable substance, and the foods of chief nutritive value which are in common use are flesh, flour and fat—beef and bread and butter—and these contain the three principal articles of food, called by physiologists "proximate principles," or what might be called "the Staff of Life."

The three proximate principles are called proteids, carbohydrates and fats.

Proteids are obtained chiefly from meat and from seeds. Corn is seed and nuts are seeds, and all the vegetable food which contains proteid in quantity great enough to make it of use as human food comes from seeds. Proteid is dead protoplasm; it is only obtained from places where protoplasm has been.

When we deal with *excretion*, which is the process of getting rid of waste material, we shall find that there is a daily loss of nitrogen, so that there must be a daily gain of nitrogen to repair that loss. Proteid is the only kind of food which contains nitrogen. Besides meat and seeds, it is also present in eggs and milk.

Carbohydrates come from vegetables only. They consist of carbon, hydrogen and oxygen, and there are two parts of hydrogen to one of oxygen, as is the case with water, and the word carbohydrate means "watered carbon." The only two carbohydrates of importance to us are starch and sugar.

There are several kinds of sugar, of which the chief are cane sugar, used for table purposes, and grape sugar, which is chemically a rather simpler body. Starch when digested becomes grape sugar, and cane sugar when swallowed is converted into grape sugar before it is absorbed.

Starch is present in many seeds, especially corn and wheat, and in tubers, such as potatoes. Sugar is present in fruit, in many roots, such as beetroot, and in the sugar cane.

Fats, including oils, are either animal or vegetable, such as the fat of meat, butter, the fat of milk, and vegetable oils like olive oil.

There is a daily loss of water, so water has to be taken with the food, and also salts, especially sodium chloride, or table salt, which is also required in the food.

A man cannot live on proteid or carbohydrate or fat alone, he requires a mixture of all three, and a sufficient diet for a healthy grown-up man doing heavy work is three-quarters of a pound of meat, a pound and a half of bread, and a quarter of a pound of fat, with water and salts. The only single substance which is a perfect food is milk, which is a mixture of all the proximate principles.

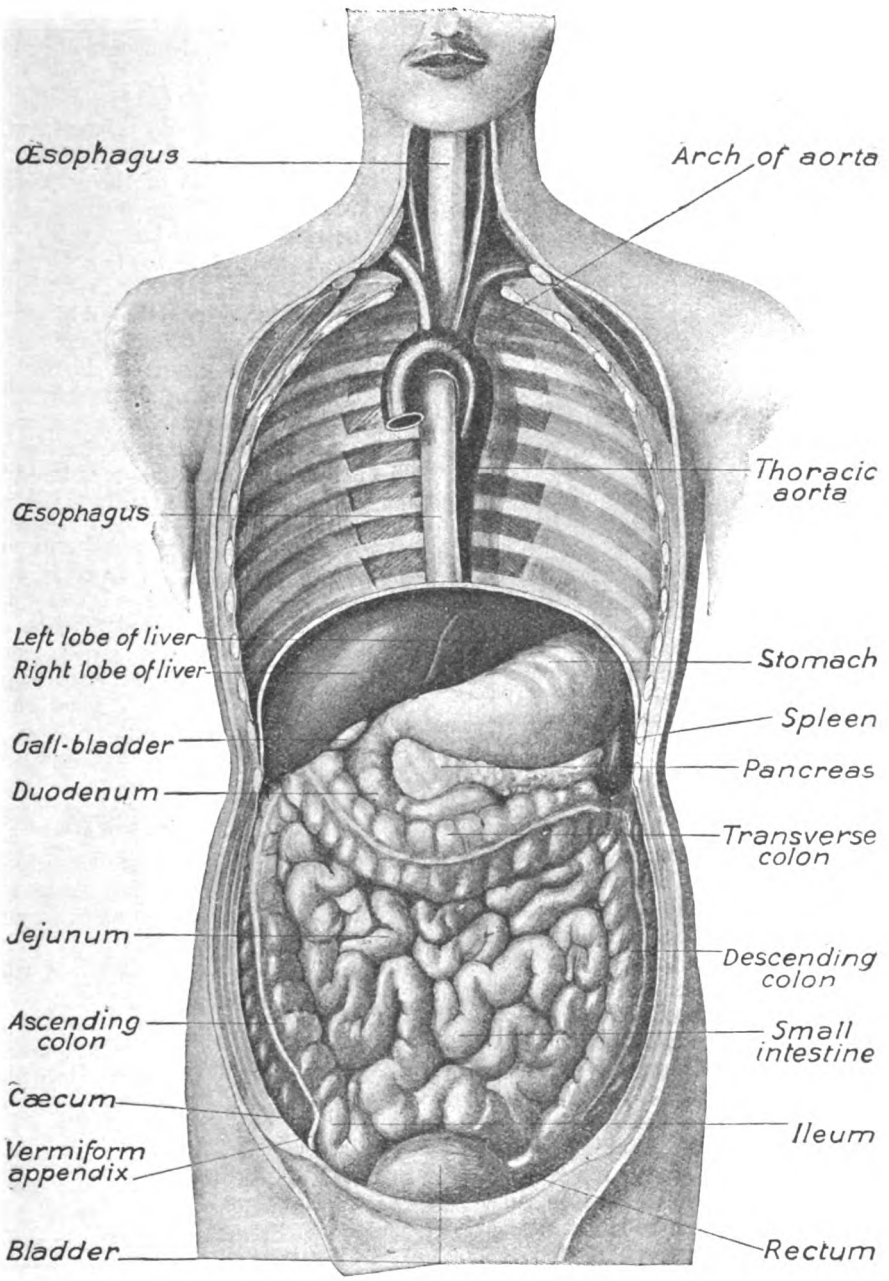
Acids and Alkalis

There are many other things in food which are important, because they make it attractive, make it smell nice and taste good, and so induce one to eat it, but it is only the proteids, carbohydrates and fats which are of value as fuel.

The food one eats is a crude material which only contains small amounts of the proximate principles, and the object of digestion is to extract those substances, and dissolve them.

In the mouth the food is mixed with saliva, which comes from some glands, the parotid in the cheek, and the submaxillary under the floor of the mouth; their ducts lead into the mouth. Saliva helps to digest starch. Starch by itself will not dissolve; when it is digested it is changed into sugar, which is easily dissolved. The saliva has no effect on proteids or fats. The digestion of starch, then, begins in the mouth.

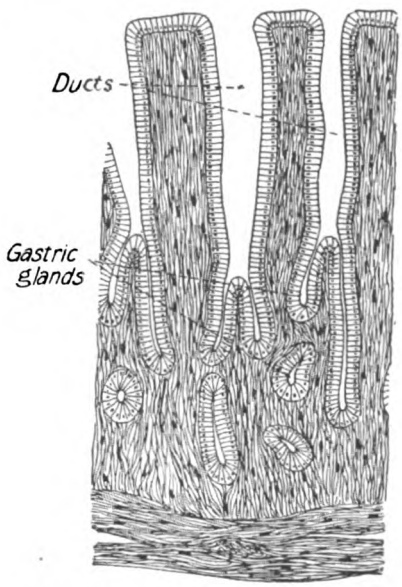
The food is swallowed into the stomach, and there the digestion of starch continues for some time, about half an hour, until the contents become acid, the saliva being alkaline. And here a word on the difference between acids and alkalis.



THE ALIMENTARY TRACT.

As soon as food is forced from the pharynx into the œsophagus, the latter starts peristalsis and the food is passed rapidly into the stomach, when the elaborate process of digestion, already begun by the action of saliva, is continued.

Hydrochloric acid is a combination of hydrogen and chlorine: if you add hydro-



GASTRIC GLANDS AND DUCTS.

The glands at the cardiac end of the stomach secrete hydrochloric acid, the glands at the pyloric end a ferment called pepsin.

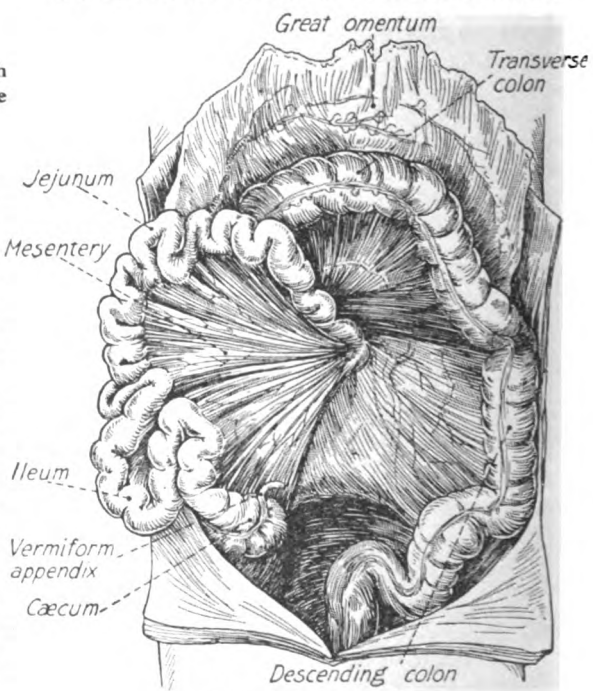
chloric acid to litmus, which is a blue dye, the litmus turns red. If you dissolve some sodium carbonate in water, and pour this into the reddened litmus, it will finally turn blue again, because sodium carbonate is an alkali. It first "neutralises" the acid, and then renders the liquid alkaline. If you put sodium carbonate, which is a combination of the metal sodium with carbon dioxide (carbon and oxygen), into hydrochloric acid there will be a fizzing; the sodium will combine with the chlorine, for which it has great affinity, and the carbon dioxide will be given off as gas. Sodium chloride (or common salt) is then formed. If you dissolve sodium chloride in water and add it to blue litmus, or to litmus reddened with acid, it will not change colour in either case; sodium chloride is a *neutral* salt.

An acid always contains hydrogen, and turns blue litmus red; it will combine with a *base*, which is often a metal, and often but not always alkaline (that is, capable of turning red litmus blue). An acid combined with a base forms a *salt*, which is generally "neutral" to litmus; that is, does not make it either red or blue.

The saliva is alkaline, so the food when it reaches the stomach is alkaline, and in saliva there is a "ferment" called ptyalin which acts on the starch and turns it into sugar, and the ferment can only act in an alkaline liquid.

The presence of food in the stomach stimulates it, and its glands, which are spread all over its inner surface, begin to secrete. The glands of the stomach are of two kinds; some at the cardiac or left-hand end secrete hydrochloric acid, and the others, at the pyloric end, a ferment called pepsin.

Many pints of gastric juice are secreted in the course of twenty-four hours, and poured into the stomach during the time that the food is being chewed in the mouth. The gastric juice is formed more quickly when the food is passed into the stomach. The inside of the stomach is lined throughout with glands which produce this digestive fluid from the blood. The glands in the mouth similarly secrete the saliva from the blood, but are confined to certain definite



THE PERITONEUM

is a serous membrane which lines the abdomen, covering the stomach and intestines and forming a sling (as shown above) by which the intestine is moored to the back of the abdomen.

masses. Pepsin is the main constituent of gastric juice; it breaks up food into the solubles—*albumoses* and *peptones*.

D. W. C.-J.

Continued from page 276.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D. Lit.). GERMAN (M. A. Lewenz, M.A. [Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XXXIII

THE student may have noted that in complex sentences in English, a past tense in the principal clause entails a past tense in the dependent clause. It is the same in Latin, but here the rule is a little more strict.

Sequence of Tenses

A primary tense in the principal clause should be followed by a primary tense in the dependent clause, and a secondary tense in the principal clause by a secondary in the dependent clause.

The student is already acquainted with the distinction between the primary tenses and the secondary or historic tenses. The following examples illustrate the rule :—

Primary tenses

Present	metuit	ne quid deperdat	*He fears*	*that he may lose something.*
Future	metuet		*He will fear*	
Future perfect	metuero		*He will have feared*	
Perfect proper	metuit		*He has feared*	
Present	metuit	ne quid deperderit	*He fears*	*that he may have lost something.*
Future	metuet		*He will fear*	
Future perfect	metuero		*He will have feared*	
Perfect proper	metuit		*He has feared*	

Secondary tenses

Imperfect	metuebat	ne quid deperderet	*He feared*	*that he might lose something.*
Aorist perfect	metuit		*He feared*	
Pluperfect	metuerat		*He had feared*	
Imperfect	metuebat	ne quid deperdisset	*He feared*	*that he had lost something.*
Aorist perfect	metuit		*He feared*	
Pluperfect	metuerat		*He had feared*	

When the historic present or infinitive is used in the principal clause, the verb in the dependent clause may be in either a primary or a secondary tense.

Dependent Questions, together with dependent requests or commands and dependent statements, are forms of the substantival clause ; in other words they constitute the subject or the object of the verb or of a verbal substantive or adjective in a principal sentence. As dependent clauses they are subject to the rules regarding moods and tenses that have just been laid down.

Dependent Clauses

The introductory particles **-nĕ**, **nonnĕ**, **num**, are used in the case of indirect simple questions, and **ŭtrum . . . ăn**, in that of alternatives, just as in direct questions (see page 210), except that **num** does not carry with it the same anticipation of a negative reply. Examples :—

Indirect question	*Direct question*
Quaerit Clodiusne (or num Clodius) abierit.	Abiitne Clodius ?
He asks if Clodius has departed.	*Has Clodius departed ?*
Quaerit quis sit Clodius, cur abierit.	Quis est Clodius ? Cur abiit ?
He asks who Clodius is, and why he has departed.	*Who is Clodius ? Why has he departed ?*
Quaerit maneatne Clodius an abierit.	Manetne Clodius an abiit ?
He asks whether Clodius is staying or has departed.	*Is Clodius staying or has he departed ?*
Rogavit eos cur tam tarde venissent.	Cur tam tarde venistis ?
He asked them why they had come so late.	*Why have you come so late ?*

Dependent Requests or Commands, when they follow the principal verb **iŭbĕō**, *command*, or **vētō**, *forbid*, are expressed by the infinitive. After other verbs they are put in the subjunctive with **ŭt**. Examples :—

Iubet Clodium abire *or* Imperat Clodio ut abeat.
He orders Clodius to depart.

Clodi, abi.
Clodius, depart.

Vetat Clodium abire, *or* Mandat Clodio ne abeat.
He enjoins Clodius not to depart.

Ne abieris, Clodi.
Do not depart, Clodius.

Dependent Statements are regularly put in the infinitive with the accusative, as in—

Promisit se venturum esse.
He promised he would come.

Veniam.
I shall come.

The verb in any dependent clause in such an indirect statement must be put in the subjunctive, as in the following example :—

Promisit se venturum esse, si in urbe maneret.
He promised he would come, if he stayed in the city.

Veniam, si manebo.
I will come, if I remain.

Indirect statements are sometimes introduced by the conjunction **quŏd**, *inasmuch as, the fact that ;* or, appear as subjects to impersonal verbs like **accĭdĭt**, *it happens*, **concēdĭtŭr**, *it is allowed* (that), after **ŭt** or **nē**. Examples :—

Fecisti mihi pergratum, quod librum ad me misisti.
You have made me very grateful, in that you have sent me the book.

Accidit ut esset luna plena.
It happened that there was a full moon.

Adjectival Clauses are introduced by a relative, agreeing in gender, number, and person with an antecedent, which is the substantive requiring definition ; thus—

Colonia, quam Fregellas appellant.
The colony which they call Fregellae.

Deorum numero eos solos ducunt quos cernunt et quorum aperte opibus iuvantur,
They number among the gods those alone whom they see and by whose powers they are manifestly benefited.

The mood of the verb in an adjectival clause is determined by the same reasons as were explained in the last lesson, as governing the mood in dependent clauses in general. These will be illustrated further under the head of adverbial clauses. In the examples just cited, the indicative is used, because the relative clause states a fact. When this clause has a causal, concessive, final, or consecutive sense, the subjunctive would naturally be employed, as in—

Misit legatos qui quererentur.
He sent ambassadors to complain.

Ea est Romana gens quae vinci nesciat.
The Roman nation is such that it knows not how to suffer defeat.

Adverbial Clauses were defined in the last lesson, eight distinct varieties being pointed out, falling into four groups—circumstantial, conditional, final, consecutive. Let us now review these in more detail, considering further examples of each, and paying special attention to the rules applying to conditional sentences.

Circumstantial Clauses. comprising temporal, local, comparative, causal, and concessive clauses, need not detain us long. The following are some further examples :—

Quum hostem occidisset, spolia legit.
When he had slain the foe, he took the spoils.

Quamvis iuvenis sim, multa didici.
Although I am young, I have learnt much.

Iratus erat, quod Caesar ita locutus est.
He was angry, because Caesar had spoken thus.

Milites, quamquam fessi erant, hostes adorti sunt.
The soldiers, although they were weary, attacked the enemy.

Final Clauses express the purpose or end of the action of the principal verb, and are introduced by **ŭt**, *in order that*, **nē**, *lest*, **quōmĭnŭs**, **quīn**, *so that not*, and other conjunctions. This conjunction is always followed by the subjunctive. Examples :—

Suades ut ad Quinctium scribam.
You persuade me to write to Quinctius.

Expectabat dum hostis adveniret.
He was waiting for the enemy to approach.

Timeo ne mortuus sit.
I fear that he is dead.

Timeo ut salvus sit.
I fear that he is not safe.

Note the difference between **nē**, *lest, that*, and **ŭt**, *that*, after verbs of fearing. The former refers to what it is feared may happen, the latter to what it is feared may not happen. Thus **ŭt** may be changed to **nē . . . nōn** without alteration of the sense, thus—

Timeo ne salvus non sit.

Verbs of forbidding or preventing take **quōmĭnŭs** or **quīn**, as in—

Prohibuit eos quin castra moverent.
He forbade them to move their camp.

Consecutive Clauses, since they express the consequence or result of an action, take the subjunctive, and are introduced by **ŭt**, *that, so that*, **ŭt nōn**, *so that not*, etc. Examples :—

Maior sum quam ut mancipium sim mei corporis.
I am too great to be the slave of my body.
Socrates tum sapiens erat ut nemo ei par esset.
Socrates was so wise that no one was his peer.
Nemo adfuit quin hac oratione gauderet.
There was no one present but (he) was delighted with this speech.

Exercise 32

Translate into English :—

1. Omnia tibi narrare longum est. 2. Statim id dicere melius fuit. 3. Potuit facile effugere, sed conari nolebat. 4. Nonne mihi olim sibi puero amico veniam indulgere victor potuit? 5. Digni autem sunt amicitia, quibus in ipsis inest cause cur diligantur. 6. Tamquam pecudes, eos potissimum diligunt, ex quibus sperant se maximum fructum esse capturos.

Translate into Latin :—

1. He gave me all the things that he had. 2. Those that have wisdom are rich. 3. Virtue is the one thing that can never fail us. 4. I promised to give him the things that he wanted. 5. I refused, because they were unwilling to give me the things that I wanted. 6. There are many people who give to others only what they do not need themselves.

Key to Exercise 31

1. The gods forbid! 2. May we die at home! 3. Do not say this or that. 4. It would have been better to spare the conquered. 5. Use your own in such a manner as not to injure that of others. 6. Since you are such a man, I would that you were one of us.

1. Literas a te accipere iamdudum cupinus. 2. Domum cras redibo. 3. Tres muri urbem tum firmabant. 4. Imprudens id fecisse visus est. 5. Aperte adulantem nemo non odit. 6. Spero me venturum esse cras.

E. A. B.

GERMAN.—XXX.

Prepositions.—We gave a list in an earlier lesson of the simple prepositions governing the genitive, dative, and accusative cases. There are, however, a number of compound prepositions and different parts of speech used in a prepositional sense which we shall enumerate now. (NOTE.—One or two of the prepositions given in the earlier lists are, strictly speaking, not simple prepositions. Thus während, *during*, is really the Present Participle of a verb währen, *to last*. Such as were included were given then because they are so commonly used that they have ceased to be regarded as anything but prepositions, and as they are of such frequent occurrence it was important for the student to become familiar with them at an early stage.)

Prepositions Governing the Genitive.—halber or halben, *for the sake of*. This always follows the noun it governs. Thus, der Kinder halben, *for the sake of the children*.

Compounds of halb. Thus, außerhalb, *outside*, innerhalb, *inside*, oberhalb, *above*, unterhalb, *below*.

Kraft, *by virtue of*, längs, *along*, laut, *according to*, ungeachtet, *notwithstanding*, unfern and unweit, *not far from*, mittels, mittelst or vermittelst, *by means of*, vermöge, *by dint of*, zufolge, *in consequence of*.

Compounds of seit such as diesseit or diesseits, *this side of*, jenseit or jenseits, *the other side of*.

Two other prepositions, namely, ungeachtet and wegen, *on account of*, may follow (though they may also precede) the noun they govern. One, zufolge, may govern a dative. In this case it follows the noun it governs; when it governs a genitive it always precedes the noun. A few adverbial genitives, such as angesichts, *in the presence*, may be used prepositionally with a genitive, as may inmitten, *in the midst*, and the compounds of wärts, nordwärts, südwärts, etc.

Prepositions Governing the Dative.—Most of these are simple prepositions, but the following must be mentioned:

gleich, *like*, nächst, *next*, entgegen, *against*, gegenüber, *opposite*, gemäß, *according to*, zuwider, *contrary to*.

Gleich, gemäß and also nach may precede or follow the noun they govern.

Entgegen, gegenüber and zuwider always follow the noun.

Prepositions Governing the Accusative.—In addition to those mentioned previously, there are bis, *till*, and sonder, *without*.

A shortened form of gegen, namely, gen, is only rarely employed in a few expressions. Thus, gen Himmel, *towards heaven*, gen Osten, *towards the east*.

Sonder is almost out of use except in the expression sonder gleichen, *without equal*.

Bis is mostly used as an adverb before a prepositional phrase, but it can directly govern expressions of time and place. Thus, bis gestern, *till yesterday*, bis Sonntag, *till Sunday*, bis Berlin, *up to* (as far as) *Berlin*.

Even in these cases it is more logical to regard bis as an adverb modifying a noun used adverbially.

A certain number of prepositions can govern a noun clause. These are auf, außer, bis, ohne, statt, anstatt, um, ungeachtet, während. The clause is usually introduced by daß, but bis, ungeachtet, während are often used without daß and are then equivalent to subordinative conjunctions. Thus, ich arbeite auf daß es dir gut gehe, *I work in order that it may go well with thee*, but er entschlüpfte während wir ihn suchten, *he slipped away while we were looking for him*.

Adverbs of direction are quite often added to prepositional phrases, to make them more

definite. The commonest of these are hin, her, and um. They may be added alone. Thus, er ging hinter dem König her, *he walked along after the king*, er fuhr über den See hin, *he went forth over the lake.*

In the phrase um ihn her, *round about him*, the idea of direction towards inherent in her is disregarded.

These adverbs may also be used compounded with the preposition itself, which thus occurs twice. Thus, aus dem Haus heraus, *forth from the house*, um die Stadt herum, *round about the town.*

Other adverbs of direction are used in a similar way. Thus, von nun an, *from now onward*, er ging auf die Frau zu, *he went towards the woman*, er kam zur Tür hinaus, *he came out from the door.*

As the use of prepositions is one of the most difficult points to master in any language, we shall now give in some detail the chief uses of the more important prepositions.

Prepositions which Govern the Dative only.—Aus, *out of*, is the opposite of in. It is used in the following ways:

(*a*) Of place: aus dem Bett steigen, *to get out of bed*, er kam aus dem Garten, *he came out of the garden*, er kommt aus Berlin, or er ist aus Berlin, means, he comes from Berlin in the sense that he is a native of Berlin; (er kommt von Berlin, means, he comes from Berlin in the sense that Berlin is the last town he was in before coming here).

(*b*) In metaphorical expressions: ein Märchen aus alten Zeiten, *a fairy tale of* (from) *olden times.*

(*c*) Of material: der Tisch ist aus Ebenholz, *the table is of ebony*, eine Form aus Eisen gegossen, *a form of cast iron*, was soll aus mir werden? *what is to become of me?*

(*d*) With verbs denoting change to denote the original condition, aus Lumpen kann man Papier machen, *paper can be made from rags.*

(*e*) For the motive of an action: er tat es aus Liebe zur Sache, *he did it for the love of the cause.*

Außer means *out of, outside of.*

(*a*) Of place: außer den Mauern, *outside the walls*, but in modern German außerhalb is mostly used in this sense.

(*b*) In metaphorical expressions: außer Frage, *out of the question*, außer sich sein, *to be beside oneself.*

(*c*) Meaning *except, besides:* sie waren alle da außer den Söhnen, *they were all there except the sons*, außer den Frauen waren noch die Kinder zu bedenken, *besides the women there were also the children to be considered.* In this sense we almost always find noch, auch or some such expression used in conjunction with außer.

Bei denotes nearness and is especially used to indicate nearness to persons. It can never be used in the sense of motion towards, but always denotes rest. It is commonest in its metaphorical uses.

(*a*) Of places: bei Berlin, *near Berlin*, die Schlacht bei Waterloo, *the battle of* (at) *Waterloo*, bei dem Konditor, *at the confectioner's*, bei Müller wohnen, *to live with Müller* (or at Müller's).

(*b*) In metaphors: bei sich haben, *to have about one, with one*, er ist nicht bei Sinnen, *he is not in his senses*, sie waren bei Tisch, *they were at table*, bei Zeiten, *in time*, er hat sich beim Laufen überhitzt, *he overheated himself in running*, bei den Franzosen, *among the French*, das findet sich oft bei deutschen Schriftstellern, *that is often to be found in* (the works of) *German writers*, bei Seite legen, *to lay aside.*

(*c*) It is often used of contemporaneous circumstances, either of single events or of general conditions: bei Sonnenuntergang traf er ein, *he arrived at sunset*, bei schönem Wetter, *in fine weather.* Some metaphorical uses are derived from this: bei Todesstrafe, *on penalty of death*, bei guter Gesundheit, *in good health.*

(*d*) To indicate the actual point of contact both physically and metaphorically: bei der Nase herumziehen, *to lead by the nose*, beim Namen nennen, *to call by name.*

(*e*) With verbs of swearing, etc.: bei Gott, *by God*, bei Leibe nicht, *not on any account.*

(*f*) With numerical expressions: Stück bei Stück, *piece by piece*, i.e. *one piece at a time.*

VOCABULARY

wie gesagt, *as stated.*
schwören, s., *to swear.*
unmittelbar, *immediate, direct.*
genießen, s., *to enjoy.*
betheuern, w., *to asseverate.*
argwohnen, w., *to suspect.*
sonst, *otherwise, in other respects.*
Verräther, s.m.1, *traitor.*
sich rächen, w., *to revenge oneself.*
zur Stelle schaffen, w., *to produce.*
Stuhl, s.m.2., *chair, seat.*
lösen, w., *to solve.*
eröffnen, w., *to open.*
Wunderkraft, s.f., *wonderful or magic power.*
zurück'wirken, *to operate backwards, react.*
betrügen, w., *to deceive.*
echt, *real.*
verloren gehen, *to be lost.*
bergen, s., *to hide.*
verklagen, w., *to sue, go to law.*
Richter, s.m.1, *judge.*
Vorrecht, s.n.2, *privilege.*
minder, *less.*
falsch, *false.*
bereit, *ready.*
bezeihen, s., *to accuse.*
ausfinden, s., *to discover.*
verlangen, w., *to desire* (when used impersonally).
weisen, s., *to dismiss.*
Räthsel, s.n.1, *riddle.*
harren, w., *to wait.*
besitzen, s., *to possess.*
entscheiden, s., *to decide.*
schweigen, s., *to be silent.*
nach außen, *outwards.*
Betrüger, s.m.1, *deceiver.*
vermuthlich, *presumably.*
Verlust, s.m.2, *loss.*
ersetzen, w., *to make good, replace.*

Exercise 67 (*Continued from No.* 65)

Nathan.—

Laß auf unsre Ring'
Uns wieder kommen[1]. Wie gesagt: die Söhne
Verklagten sich; und jeder schwur dem Richter,
Unmittelbar aus seines Vaters Hand
Den Ring zu haben[2] — wie auch wahr[3]! — nachdem
Er von ihm lange[4] das Versprechen schon
Gehabt[4], des Ringes Vorrecht einmal zu
Genießen — Wie nicht minder wahr[5]! — Der Vater[6]
Bet'heu'rte[7] jeder, könne gegen[8] ihn
Nicht falsch gewesen seyn, und eh' er dieses
Von ihm, von einem solchen lieben Vater,
Argwohnen laß'[9]: eh'[10] müss' er seine Brüder,
So gern[11] er sonst von ihnen nur das Beste
Bereit zu glauben sey, des falschen[12] Spiels
Bezeihen; und er wolle die Verräther
Schon auszufinden wissen[13]; sich schon rächen[14].

Saladin.—

Und nun[15], der Richter? — Mich verlangt zu hören,
Was du den Richter sagen lässest[16]. Sprich!

Nathan.—

Der Richter sprach: wenn ihr mir nun den Vater
Nicht bald zur Stelle schafft, so weis' ich euch
Von meinem Stuhle[17]. Denkt ihr, daß ich Räthsel
Zu lösen da bin? Oder harret ihr,
Bis daß der rechte Ring den Mund eröffne[18]? —
Doch[19] halt! Ich höre ja, der rechte Ring
Besitzt die Wunderkraft beliebt zu machen;
Vor Gott und Menschen angenehm. Das muß
Entscheiden! Den die falschen Ringe werden
Doch das nicht können! — Nun, wen lieben zwei
Von euch am meisten? — Macht[20], sagt an! Ihr schweigt?
Die Ringe wirken nur zurück? und nicht
Nach außen? Jeder liebt sich selbst nur
Am meisten? — O so[21] seyd ihr alle drei
Betrogene Betrüger! Eure Ringe
Sind alle drei nicht echt. Der echte Ring
Vermuthlich ging verloren. Den Verlust
Zu bergen, zu ersetzen, ließ der Vater
Die drei für einen machen.

Saladin.—

Herrlich! Herrlich!

NOTES:—

(1) auf etwas wieder kommen, *to return to.* (2) haben, in English we must supply some such word as "received" after this. Note the German use of the Infinitive with zu after schwören. (3) wie auch wahr, the finite verb war (*was*) must be supplied here. (4) lange . . . schon, *a long time ago*; the auxiliary hatte must be understood with gehabt. (5) wie . . . wahr, *see* (3). (6) der Vater . . . rächen, all this, with the exception of the parenthesis bethеu'rte jeder, is an indirect statement of what the sons said, and therefore all the principal verbs are in the Conjunctive mood. (7) bethеu'rte for betheuerte, the e is elided on account of the metre. (8) gegen jemand falsch sein, *to play someone false.* (9) lass' for lasse, the pres. conj. of lassen; for the elision of the e *see* (7); ihn . . . lasse, *sooner than . . . he should let.* (10) eh' müss', *see* (9). (11) so gern er sonst bereit sey, *however gladly he would otherwise be ready.* (12) falsches Spiel, *cheating.* (13) wissen having an infinitive with zu depending on it means *to know how.* (14) rächen, this infinitive, like wissen, depends on wolle. (15) und nun, der Richter? *well, what about the judge?* or, *what did the judge say?* (16) lässest here used in the causative sense. (17) Richterstuhl is judgment-seat or tribunal. (18) eröffne, conjunctive in an adverbial clause of time; compare the older English use of the subjunctive after till, e.g. "till one greater Man restore us and regain the blissful seat." (19) doch, *surely.* (20) macht, sagt an, *come, tell me,* or *confess.* (21) so, *then.*

VOCABULARY

fascinate, bezaubern, w.
shore, Ufer, s.n.1.
tempt, verlocken, w., anziehen, s. sep.
cheek, Wange, w.f
Greek, griechisch.
suppose, glauben, w
read, lesen, s.
good for nothing, Taugenichts, s.m.1.
general, General, s.m.2.
almost, beinahe.
keep, erhalten, s.
sack, Sack, s.m.2.
like, liebhaben.
talking, Gespräch, s.n.2.
nonsense, Unsinn, s.m.
escaping, Entwischen, s.n.1.
rescuing, Befreiung, w.f.
island, Insel, w.f.
student, Student, w.m.
delight, entzücken, w.
fruit, Obst, s.n.
still, noch.
Eve, Eva.
Livy, Livius.
grammar, Grammatik, w.f.
novel, Roman, s.m.2.
clean, rein.
sensible, vernünftig.
lock up (a person), einschließen, s. sep.
box, Kiste, w.f.
Charles, Karl.
cut himself out, sich herausschneiden, s.
mention, nennen, w.
love, Liebelei, w.f.
sort, Art, w.f.
fighting, Gefecht, s.n.2.
robbery, Raub, s.m.2.
swim, schwimmen, s.

Exercise 68 (*Continued from* 66)

What was it that so fascinated the young student, as he stood by the river shore?[1] Not the Pons Asinorum. What book so delighted him, and blinded[2] him to all[3] the rest of the world, so that he did not care[4] to see the apple-woman with her fruit, or (more tempting[5] still to sons of Eve) the pretty girls with their apple-cheeks, who laughed and prattled round the fountain? What was the book? Do you suppose[6] it was Livy, or the Greek[7] grammar? No; it was a novel that you[8] were reading, you lazy, not very clean, good-for-nothing, sensible[9] boy! It was D'Artagnan locking[10] up General Monk in a box, or almost succeeding[11] in keeping[12] Charles[13] the First's head on.[14] It was the prisoner of the Chateau d'If cutting himself out of the sack fifty feet[15] under water (I mention the novels I like best myself—novels without love or talking, or any of that sort of nonsense,[16] but containing[17] plenty[18] of fighting, escaping, robbery, and rescuing) —cutting himself out of the sack, and swimming to the island of Monte Cristo.

NOTES:—

(1) *River shore*—make a compound Flußufer, and use auf for by. (2) *Blinded*, say *made him blind to* (gegen). (3) *All . . .* world, die ganze übrige Welt. (4) *He did . . . care to*, er machte sich nichts daraus. (5) *Tempting*, say *what tempts more.* (6) *Do . . . suppose*, insert wohl to make the use of glauben (literally, to believe) more vague. For *you* use the 2nd pers. plur. ihr. (7) *Greek*—the student is reminded that adjectives formed from names of countries are not written with capitals in German. (8) *You* —use the 2nd pers. sing. du. (9) *Sensible*—place this after clean and use good-for-nothing as a noun, omitting boy. (10) *Locking*—this and the following Present Participles, succeeding, cutting, swimming, must be rendered by adjectival clauses introduced by relative pronouns. (11) *Succeeding*—remember that this verb is used impersonally in German and governs a dative. (12) *Keeping*—use the Infinitive with *to.* (13) *Charles the First's*—both the name and

the ordinal must be in the genitive in German. (14) *On*—supply his shoulders after *on—shoulder*, Schulter, w.f. (15) *Feet*—use the singular. (16) *Any . . . nonsense*, say *any nonsense of that sort*. (17) *Containing*, say *which deal with* (handeln von). (18) *Plenty . . . rescuing*—put *fighting* and *rescuing* in the plural and place *plenty* (die Menge) after them.

Key to Exercise 65

Saladin (*who has turned from him in consternation*).—I hear, I hear. Make an end of your story (come to end with your story) quickly. Hurry.

Nathan.—I have finished (I am at the end). For what still follows is surely self understood.—Hardly was the father dead, when each one comes with his ring, and each claims to be the head (prince) of the house. They examine, they quarrel, they go to law. In vain; it was impossible to discover which was the true ring (the true ring was not demonstrable).—

(*After a pause, in which he awaits the Sultan's answer*)—

Almost as impossible as it is now for us to discover —the true religion.

Saladin.—What? That is to be the answer to my question? . . .

Nathan.—That is only to excuse me if I do not dare (trust myself) to distinguish between the rings which the father had made with the purpose that they should not be distinguishable.

Saladin.—The rings.—Do not mock (play with) me.—I should think that the religions which I named to you were surely distinguishable. Even as regards clothing; even as regards food and drink.

Nathan.—And only not so as regards their fundamentals.—For are they not all founded on history, written or handed down by tradition?—And history must surely be accepted upon trust?—Is that not so?—Now upon whose good faith does one least cast doubts? Surely one's own people's? Surely those of whose blood we are? Surely those who from childhood have given us proofs of their love? who have never deceived us, except where it was more beneficial for us to be deceived?—How can I believe my fathers less than you believe yours? Or conversely: can I expect you to accuse your ancestors of lying, so as not to contradict mine? Or conversely. The same holds good for the Christians. Is that not so?

Saladin.—By the living God! The man is right, I can say nothing (I must grow dumb).

Key to Exercise 66

Es war dort ein reizend schöner Spaziergang den Fluß entlang den wir des Abends machten, und wir beobachteten die Berge die sich zu einem tieferen Purpur verdunkelten; die Schatten welche die goldenen Mauern hinaufschlichen; den Fluß der rauschte, die Kühe welche blökten, die Mädchen und Schwatzbasen um die Springbrunnen, welche plapperten und kreischten; und mehrmals trafen wir einen trägen schwerfälligen Jungen, einen langgliedrigen Burschen, mit einem abgetragenen Rock, und Hosen nicht zu lang, und großen Füßen die sich träge einer nach dem andern schleppten, und großen trägen Händen die aus den engen Ärmeln hinausschlenkerten, und in den trägen Händen ein kleines Büchlein, welches der Knabe sich vor's Gesicht hielt, und welches ihn wahrscheinlich so bezauberte und entzückte, daß er gegen die Schönheit um ihn her blind war; ich würde wetten, daß er der Lektionen uneingedenk war die er auf morgen zu lernen hatte; vergessend die Mutter die mit dem Abendessen wartete, und den Vater der eine Strafpredigt vorbereitete; — ganz und gar vertieft in sein Buch.

M. A. L.

RUSSIAN—XXII

231. The Preposition съ, со, *of, off, out, from, on, since, about,* (together) *with,* governs:

I. The Genitive, when denoting beginning, starting point, or cause of some action or event—translated, *from.*

II. The Accusative, when denoting approximateness of size or space—translated, *about.*

III. The Instrumental, when denoting complicity, purpose or manner of action—translated, (together) *with.*

Examples

I

Со дня на́ день,	*from day to day.*
Прочь, съ мои́хъ глазъ,	*away, out of my sight* (eyes).
Съ отча́янія,	*through despair.*
Съ про́шлаго мѣ́сяца,	*since last month.*
Снять со сто́ла́,	*to clear the table.*
Съ тѣ́хъ поръ,	*since that time.*
По́шлина съ табаку́,	*the duties on tobacco.*
Не знать съ чего́ на́чать,	*not to know where* (with what) *to begin.*
Привы́кнуть съ дѣ́тства,	*to get accustomed from childhood.*
Съ утра́ до ве́чера,	*from morning till evening.*
Съ на́шей стороны́,	*from our side.*
Съ э́той то́чки зрѣ́нія,	*from this point of view.*

II

Проѣ́хать съ ми́лю,	*to travel over* (drive, ride) *about a mile.*
Прожи́ть въ Пари́жѣ съ го́дъ,	*to live in Paris about a year.*
Алма́зъ величино́ю съ бобъ,	*a diamond of the size of a bean.*

III

Договори́ться съ покупа́телемъ,	*to make a contract with the client.*
Съ намѣ́ре́ніемъ, умы́сломъ,	*with the intention, design.*
Съ трудо́мъ,	*hardly.*
Съ больши́ми затрудне́ніями,	*with great difficulties.*
Съ по́мощью, содѣ́йствіемъ,	*with the aid, co-operation.*
Съ цѣ́лью,	*with the object.*

232. The Preposition по, *on, at, by; up to; after,* governs:

I. The Dative, when denoting the surface of an area, the reason, cause and manner of an action, also limit of some measure—translated, *on, at, by.*

II. The Accusative, when denoting

limitation of space or time—translated, *by, up to.*

III. The Prepositional, in answer to the question, when ?—translated, *after.*

Examples

Гуля́ть по го́роду,	*to have a walk through town.*
Ѣхать по желѣзной доро́гѣ,	*to travel by railway.*
Суди́ть по нару́жности,	*to judge by the appearance.*
Бездѣйствовать по боле́зни,	*to be inactive through illness.*
По слу́чаю пра́здника,	*on account of holiday.*
По бѣдности,	*through poverty.*
По со́вѣсти, че́сти, до́брой во́лѣ,	*conscientiously, honourably, in* (by) *good will.*
По моему́ мнѣнію, возрѣнію,	*in my opinion, view.*
По жела́нію,	*at will.*
По э́тому вопро́су,	*on this question.*
По обою́дному согла́сію,	*by mutual consent.*
По обыкнове́нію,	*as usual.*
По оцѣнкѣ,	*as valued.*
По ка́плѣ, ло́жкѣ, рублю́,	*a drop, spoonful, rouble each time or each person.*
Смотря́ по на́добности,	*as required, according to requirements.*

II

По сіе́ вре́мя,	*up to this time.*
Залѣзть по у́ши,	*to get involved up to the ears.*

III

По прі́ѣздѣ домо́й,	*after* (on) *coming back home* (from a journey).
По оконча́ніи дѣла,	*after* (on) *finishing the work.*
По соверше́ніи догово́ра,	*after* (on) *having concluded the contract.*
По начерта́ніи пла́на,	*after having drawn up the plan.*

VOCABULARY

До безконе́чныхъ предѣловъ, *indefinitely.*
коммерса́нтъ, *business man, merchant.*
имѣющій торго́выя сноше́нія, *trading with.*
навѣрно́е (навѣрно), *certainly.*
бу́детъ интере́сно, *it will be of interest.*
туда́, *thereto.*
въ издѣліяхъ, *manufactured.*
хими́ческія вещества́, *chemicals.*
въ свою́ о́чередь, *in its turn, on the other hand.*
цѣнностью, *of the value.*
госуда́рство, *a country.*
такъ что, *so that.*
послѣдніе, *the latter.*
поста́влены, *are placed.*
благопрія́тное, *favourable.*
положе́ніе, *position.*
грома́дный, *enormous.*
госуда́рство, *State.*
среди́, *among.*
затѣмъ, *further.*
замѣча́ть, *to notice.*
хлѣба́, *cereals.*
то́ есть, *such as.*
въ приложе́ніи, *enclosed.*
найти́, *to find.*
спи́сокъ, *a list.*
кра́ткій, *short, in a concise form.*
вы́везенный, *exported.*
аптека́рскія принадле́жности, *drugs.*
для лицъ, *to persons.*
комме́рческія сфе́ры, *commercial spheres, community.*
бы́ло бы ва́жнымъ, *would be worth while, important.*
изуча́ть, *to study.*
наско́лько, *how far.*
вы́шеуказанныя, *the above shown.*
проце́нтныя отноше́нія, *percentages.*
Имѣемъ надёжду, *we hope.*
комме́рція, торго́вля, *the trade.*
постепе́нно, *gradually.*
ме́жду, *between.*
Центра́льныя Го́сударства, *Central Powers.*
Сою́зныя Госуда́рства, *the Allies, allied countries.*
при до́лжномъ внима́ніи, *if properly handled.*
респу́блика, *republic.*
могло́ бы, *ought.*
быть ра́звита, *to develop.*
наступле́ніе, *the outbreak.*
война́, *war.*
Европе́йская, *European.*
вели́кая, *great.*
положи́ть коне́цъ, *to put an end.*
Герма́нія, *Germany.*
А́встрія, *Austria.*
Булга́рія, *Bulgaria.*
Ту́рція, *Turkey.*
таково́е обстоя́тельство, *this circumstance.*
должно́ бы́ло, *should.*
;ать возмо́жность, *enable.*
обезпе́чить за собо́ю, *to secure.*
значи́тельная часть, *a large part.*
до сихъ поръ, *hitherto.*
была́ произведена́, *was done.*
представля́етъ собо́ю, *is.*
обши́рный ры́нокъ, *an immense market.*
вели́кая бу́дущность, *a great future.*
ру́сскіе лю́ди, *the Russians.*
о́чень хорошо́ располо́жены, *are well disposed.*
къ ихъ сою́зникамъ, *towards their Allies.*
главнѣйшій, *the principal, main.*
гвезённый, *imported.*
сто́имость, *cost, value.*
навѣрно́е, *certainly.*
быть о́чень интере́сно, *to be of great interest.*
имѣть предъ собо́ю, *to have placed before him.*
подро́бности, *particulars, details.*
кра́ткая фо́рма, *a concise form.*
а та́кже, *as also.*
въ томъ же, *in, during the same.*
одновре́менно съ тѣмъ, *at the same time.*
Вы бы могли́, *you might.*
соста́вить, *draw up.*
соста́вившій, *forming, that formed.*
съ сноше́ніяхъ, *in the relations.*
міръ, *the world.*
весь, *the whole.*
за тотъ, *for the same.*
періо́дъ, *period.*
съ нѣкотораго вре́мени, *for some years.*
всё бо́лѣе увеличи́вался, *has been increasing.*
въ осо́бенности, *especially.*
въ отноше́ніи, *as regards.*
включа́я, *including.*
кро́мѣ того́, *and besides.*
ра́зныя, *different.*
съ друго́й стороны́, *on the other hand.*
продолжа́я, *continuing.*
въ проце́нтныхъ отноше́ніяхъ, *in the percentage of.*
распредѣле́ніе, *the distribution.*
въ ка́чествѣ, *as, to be.*
поста́вщикъ, *a supplier.*
ввози́чикъ, импортёръ, *an importer.*
происхожде́ніе, *origin.*
нѣтъ основа́нія, *there is no reason*
вывози́мый, *exported.*
получа́ть, *to take.*
приблизи́тельно, *some.*
состоя́щій, *consisting.*
сѣмя, сѣмена́, *seed, seeds.*
общій, *general.*
ру́сскіе вы́возы, *the Russian exports.*
въ заключе́ніе, *to conclude.*
упомяну́ть, *to mention.*

A. C.

ITALIAN.—X

The Verb. — THE endings of all verbs, regular and irregular, in the future tense are like those of **avere**, -ò, -ái, -à, -emo, -ete, -anno, as :—

Compare (reg.), *to buy*

Comprerò, comprerái, comprerà, compreremo comprerete, compreranno, *I shall buy*, etc.

Consegnare (reg.), *to deliver*

Consegnerò, consegnerái, consegnerà, consegneremo, consegnerete, consegneranno, *I shall deliver*, etc.

NOTE : -are always becomes -erò, etc., in the future indicative.

Véndere (reg.), *to sell*

Venderò, venderái, venderà, venderemo, venderete venderanno, *I shall sell*, etc.

Partire (reg.), *to depart, set out*

Partirò, partirái, partirà, partiremo, partirete, partiranno, *I shall depart*, etc.

Potere (irreg.), *to be able*

Potrò, potrái, potrà, potremo, potrete, potranno, *I shall be able*, etc.

Infinitive	*Future*
Andare (irreg.), *to go.*	andrò, etc.
Dare (irreg.), *to give.*	darò, etc.
Dire (irreg.), *to say.*	dirò, etc.
Éssere (irreg.), *to be.*	sarò, etc.
Fare (irreg.), *to do, make.*	farò, etc.
Morire (irreg.), *to die.*	morirò *or* morrò, etc.
Ottenere (irreg.), *to obtain.*	otterrò, etc.
Sapere (irreg.), *to know.*	saprò, etc.
Scégliere (irreg.), *to choose.*	sceglierò *or* scerrò, etc.
Tenere (irreg.), *to hold.*	terrò, etc.
Vedere (irreg.), *to see.*	vedrò, etc.
Venire (irreg.), *to come.*	verrò, etc.
Volere (irreg.), *to be willing.*	vorrò, etc.

Examples :—

Saprò domani chi ha fatto questo,	*I shall know to-morrow who has done this.*
Gli Americani, gli Italiani (gl'Italiani) e gli Inglesi (gl'Inglesi) avranno combattuto insieme contro i Tedeschi,	*The Americans, Italians, and English will have fought together against the Germans.*
Vedremo le casse e le balle nel magazzino,	*We shall see the cases and the bales in the warehouse.*
Partirà questa settimana per Italia,	*He will leave this week for Italy.*
Quando potrete partire, oggi o domani ?	*When will you be able to depart, to-day or to-to-morrow ?*
Scriverete le vostre léttere negli uffici dei vostri amici,	*You will write your letters in your friends' offices.*
Sarà dopodomani che andranno a Parigi,	*It will be the day after to-morrow that they will go to Paris.*
Ieri o avantieri (ier l'altro) mi hanno detto che partiranno fra poco per Venezia,	*Yesterday or the day before yesterday they told me that they will set out shortly for Venice.*
Chi vivrà, vedrà,	*We shall see in the end* (he who will live, will see).
Verrete da me questo dopopranzo (pomeriggio) ?	*Shall you come to my house this afternoon ?*
Mi contenterò di poco,	*I shall be satisfied with little.*
È ricchíssimo adesso, ma morrà (morirà) poverissimo,	*He is very rich now, but he will die very poor.*
Venderete le vostre case ?	*Shall you sell your houses?*
Scerremo (sceglieremo) due o tre bei disegne da questo collo,	*We shall choose two or three nice designs from this package.*
Se otterrete la licenza (il permesso) dalle Autorità, spediremo la merce, ma non altrimenti,	*If you obtain the licence from the Authorities, we shall forward the goods, but not otherwise.*
Venderemo senza fallo tutta la nostra esistenza di mercanzíe,	*We shall sell all our stock of goods without fail.*
Compreranno abbastanza per un anno intero, se potranno,	*They will buy enough for a whole year, if they can.*
Quando ci consegnerete le cento pezze ?	*When shall you deliver to us the hundred pieces ?*
Quando avrò la consegna dal fabbricante,	*When I have* (fut.) *the delivery from the manufacturer.*
Ha detto che farà tutto per noi,	*He has said that he will do everything* (all) *for us.*
Avévano fatto il viaggio a Londra ?	*Had they made the journey to London ?*
No, ma noi avevamo fatto questo viaggio,	*No, but we had made this journey.*
Abbiamo eseguito l'órdine come conviénsi (= come si conviene),	*We have executed the order properly.*
Non avevate ancora ricevuto l'órdine di trenta colli ?	*Had you not yet received the order for thirty packages ?*
Avevo ricevuto tutti gli órdini e avevo spedito un collo,	*I had received all the orders and I had forwarded one package.*
Avrà egli pagato il conto ?	*Will he have paid the account ?*
Avrà pagato il saldo del conto,	*He will have paid the balance of the account.*
Avremo spedito la mercanzía (la merce) sotto la garanzía del fabbricante,	*We shall have forwarded* (shipped) *the goods under the guarantee of the manufacturer.*
I fabbricanti (manifattori) avranno consegnato domani a noi e a voi tutte le mercanzíe,	*The manufacturers will have delivered all the goods to us and to you to-morrow.*
Avró ben presto (tosto) avviso dallo spedizioniere,	*I shall soon have advice from the forwarding agent.*
Oggi avrete una lettera da me.	*To-day you will have a letter from me.*

VOCABULARY

chi, *who.*
che cosa, *what.*
doman l'altro, *the day after to-morrow.*
studiare, *to study.*
il banchiere, *banker.*
la pace, *peace.*
il venditore, *salesman, seller.*
forno, m., *oven.*
consentire, *to permit.*
conserva, f., *store-room.*
ricco, *rich.*
póvero, *poor.*
stasera, *this evening, to-night.*
il concerto, *concert.*
imbarcare, *to ship.*
per lo più, *for the most part.*
per lo meno, *at least.*
fornáio, m., *baker.*
fossa, f., *ditch.*
frase, f., *phrase.*

Exercise 19

Translate into English :—

1. Sapremo domani chi ha fatto ciò. 2. Quando vedrete i colli nel magazzino ? 3. Che cosa vedrete quando verrete ? 4. Noi vedremo molto, ma voi vedrete poco. 5. Quando andrete al teatro, oggi domani o dopodomani (doman l'altro) ? 6. Che (cosa) scriverete nello studio dell 'amico ? 7. Avete fatto questo oggi, ieri o avantieri (ier l'altro) ? 8. Partiremo fra poco per Roma. 9. Potremo vedere gli amici questo dopopranzo (pomeriggio). 10. Dove sarete stasera ?

Exercise 20

Translate into Italian :—

1. The students will see the merchants and the bankers at the friends' houses. 2. We shall buy these goods on the word of the salesman. 3. We have done this for the buyers in the foreign houses. 4. We shall see the package when we are with the customers at the houses of the merchants. 5 We shall obtain from the authorities the licence to (per) ship the cases. 6. I am rich now, but I shall die poor if I am not able (shall not be able) to obtain the money. 7. Shall you have sent the patterns to the customers when I come (shall come) to your office this afternoon ? 8. He had not much time this morning, but he has written all the invoices and all the letters. 9. Where shall you go to-night, to the theatre or to the concert with the student and with the manufacturers ? 10. This week we shall have paid all our invoices, without fail.

Key to Exercise 9

1. He says that he coughs all night and that now he feels very bad. 2. I am sorry to tell you, as I have told (it to) them, that the seller (salesman) lies every time he opens his mouth. 3. After a day of fatigue I sleep like a top. 4. You must not forget the proverb : "The early bird catches the worm." 5. They consent to our proposal, since they cannot act otherwise. 6. Thence it follows clearly that they regret having run away from the creditors. 7. He always dresses himself in haste and leaves by the half-past eight train. 8. The present (letter) serves to (*or* : with the present we inform you) inform you that we have established ourselves in this place (market). 9. I am sorry to have to tell you that I never enjoy myself at Mr. Rossi's.

Key to Exercise 10

1. Confidiamo loro la compra di tutte le nostre mercanzíe nel loro mercato. 2. Son lieto di sapere (sentire) che avete l'intenzione di farmi presto una rimessa. 3. Ci è riescito esitare tutto l'invío del filato di lana a bubni prezzi. 4. Se tosse tanto e si sente così male, perchè non consulta un médico ?

A. C.

SPANISH.—X

Subjunctive Mood. — The Imperfect, Future and Conditional Subjunctive endings are formed by removing the termination "**-ron**" of the 3rd Person Plural Past Definite, Indicative Mood, and putting in its place the endings : **-se, -re, -ra,** as follows :—

Imperfect Subjunctive : -se, -ses, -se, -semos, -seis, -sen.

Future Subjunctive : -re, -res, -re, -remos, -reis, -ren.

Conditional Subjunctive : -ra, -ras, -ra, -ramos, -rais, -ran.

Example

vender, *to sell.* Past Definite, vendi**eron.**

Imperfect Subjunctive : vendiese, vendieses, vendiese, vendiésemos, vendieseis, vendiesen.

Future Subjunctive : vendiere, vendieres, vendiere, vendiéremos, vendiereis, vendieren.

Conditional Subjunctive : vendiera, vendieras, vendiera, vendiéramos, vendierais, vendieran.

The importance of this rule will be evident when it is pointed out that the rule applies, without a single exception, to every verb, regular or irregular.

The student should practise writing out the remaining persons of the three tenses of the Subjunctive given on p. 346.

Examples

Bueno fuera (sería) que Vs. nos diesen (dieran) una descripción del cliente, para que le conozcamos (from conocer) cuando le veamos á él.

It would be a good thing if you were to give us a description of the customer, so that we may know him when we see him.

Querríamos que V. nos pusiese (pusiera) un telégrama (or telegrama) cuando llegue á su destino.

We should like you to send us a telegram when you arrive at your destination.

Cuando venza (from vencer) la letra, le suplicamos á V. la satisfaga, pues de otro modo sería posible que se hiciesen (hicieran) dificultades.

When the bill falls due, we request you to settle (pay) it, as otherwise it would be possible that difficulties would be made (literally, would make themselves).

VOCABULARY

reduzcan (3 pl. pres. subj. of reducir), *to reduce.*
sigamos (1 pl. pres. subj. of seguir), *to follow.*
tuerza (3 sing. pres. subj. of torcer), *to twist, turn.*
la llave, *the key.*
la puerta, *the door.*
contribuyo (contribuir), *I contribute.*
los fondos, *the funds, money.*
la sociedad, *the company, society, partnership.*
la caridad, *the charity.*
obrar, *to act.*
solo (adj.), *single, only.*
exactamente, *exactly.*
actual (adj.), *present, actual.*
el estado, *the state, condition.*
¡ áviseme V. !, *advise me.*
unos pocos (m.), *a few.*
de antemano, con (tres días, etc.), de anticipación (three days, etc.), *beforehand.*
caber en, *to go into, find room in, to be contained in.*

Infinitive	*Past Def.* ellos	*Impf. Subj.* yo	*Fut. Subj.* yo	*Cond. Subj.* yo
comprar, *to buy*	compraron	comprase	comprare	comprara
suplir, *to supply*	suplieron	supliese	supliere	supliera
andar, *to go*	anduvieron	anduviese	anduviere	anduviera
estar, *to be*	estuvieron	estuviese	estuviere	estuviera
caber, *to find room, to be contained*	cupieron	cupiese	cupiere	cupiera
conducir, *to conduct*	condujeron	condujese	condujere	condujera
dar, *to give*	dieron	diese	diere	diera
decir, *to say*	dijeron	dijese	dijere	dijera
dormir, *to sleep*	durmieron	durmiese	durmiere	durmiera
erguir, *to raise, erect*	irguieron	irguiese	irguiere	irguiera
haber, *to have*	hubieron	hubiese	hubiere	hubiera
hacer, *to make, to do*	hicieron	hiciese	hiciere	hiciera
morir, *to die*	murieron	muriese	muriere	muriera
pedir, *to ask*	pidieron	pidiese	pidiere	pidiera
poder, *to be able*	pudieron	pudiese	pudiere	pudiera
poner, *to put*	pusieron	pusiese	pusiere	pusiera
querer, *to wish*	quisieron	quisiese	quisiere	quisiera
reir, *to laugh*	rieron	riese	riere	riera
saber, *to know*	supieron	supiese	supiere	supiera
satisfacer, *to satisfy, settle* (a bill)	satisficieron	satisficiese	satisficiere	satisficiera
sentir, *to feel*	sintieron	sintiese	sintiere	sintiera
ser, *to be*	fueron	fuese	fuere	fuera
tener, *to have*	tuvieron	tuviese	tuviere	tuviera
traer, *to carry*	trajeron	trajese	trajere	trajera

el cual, los cuales, / la cual, las cuales, — *which* (relative pronoun).
la explicación, *the explanation.*
pida, (3 sing. pres. subj. of pedir), *to beg, to ask for.*
tal, *such.*
la conducta, *the conduct, behaviour.*
sabrá (from saber), *he will know.*
la lástima, *the pity, grief, sorrow.*
duerma (3 sing. pres.subj. of dormir), *to sleep.*
levantarse, *to get up, rise.*
en lo sucesivo, *in the future.*
en lo venidero, *in the future.*
el mueble, *the piece of furniture.*
los muebles, *the* (pieces of) *furniture.*
la sala, *the room, living-room.*
me acuerdo (from acordarse), *I remember.*
por escrito, *in writing.*
pésimo (adj.), *very bad.*
la ausencia, *the absence.*
esperar, *to expect, hope.*
cuanto, *how much.*
la necesidad, *the necessity, need.*
enérgicamente, *energetically.*
suponer (conjugated like poner), *to suppose.*
sólo, solamente (adverb), *only, alone.*
todo, *everything, all.*
el pupitre, *the desk.*
fácilmente, *easily.*
la energía, *the energy.*
el empleo, *the employment.*
la satisfacción, *the satisfaction.*
el procedimiento, *the proceeding.*
visto que, ya que, *seeing that.*
el més próximo, / el més que viene, — *next month.*
andar de ceca en meca, *to go wandering about.*
¿ quién ?, *who ?*
los negocios, *the business.*
tres veces, *three times.*
acordarse de, *to remember.*
recordar, *to remember.*
lo que, *what, that which.*
acabar, *to finish.*
extrañarse, *to be astonished.*
nos extrañábamos, *we were astonished.*
extravagante (adj.), *extravagant.*
la remuneración, *the remuneration.*
la ocasión, *the occasion, opportunity.*
bien (adverb), *well.*

Exercise 17

Translate into English :—

1. De miedo que V. no conozca al cliente, le daré á V. una descriptión de él. 2. Cuando venza la letra, V. deberá satisfacerla, es decir, pagarla. 3. Es menester que Vs. reduzcan lo más posible muestra pérdida, si quieren que sigamos haciéndoles pedidos. 4. ¡ Tuerza V. la llave y se abrirá la puerta ! 5. Contribuyo á los fondos de todas las sociedades de caridad á las cuales contribuyen ellos. 6. Sin que él pida la explicación de tal conducta, no sabrá que hacer. 7. Es lástima que duerma V. tan tarde cada mañana, y será necesario que se levante más temprano en lo sucesivo. 8. Suplico á V. que en lo venidero piense más en lo que hace. 9. Venga V. aquí y dígame lo que ha oído y visto en la ciudad. 10. Aunque valgamos tanto, nunca recibiremos un sueldo tan grande.

Exercise 18

Translate into Spanish :—

1. I should like you to send (tr. I should wish that you sent, Impf. Subj. of poner, *to put*) a telegram to me each day during my absence. 2. He turns the key but the door does not open so easily as we expected (were expecting). 3. If they only knew how much we have to do, they would not ask us to do (that we should do) all that work. 4. We should like you to call and see us to-morrow or the day after to-morrow, if you are able. 5. They did (Past. Def.) this in order that you might feel the necessity of acting energetically. 6. Were your father to die (if your father died) you would remain without a single friend in the world. 7. You (pl.) did not tell them that story in order that they should laugh, but so that they might know exactly the present state of (the) things. 8. Advise me a few days beforehand when the bill falls due, and I will send you the necessary money (funds).

A. C.

Continued from page 280.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).

ASIA.—VI

ASIA MINOR, or Turkey in Asia, the greater part of which is comprised in the Mesopotamian basin, is a region difficult to deal with simply. It has neither physical nor political unity, and the races that inhabit it are very varied. We may consider it as consisting of Anatolia and Armenia in the north, Syria to the west, and Mesopotamia; but these divisions are not to be taken as representing distinct political boundaries or racial delimitations.

Anatolia is bounded on three sides by the sea; the Black Sea and the Sea of Marmora on the north, the Ægean Sea in the west, and the Mediterranean Sea on the south. Its eastern boundary is indefinite. It slopes gradually from the Taurus and Anti Taurus Mountains in the south and east towards the Ægean Sea. These great mountain ranges have their highest elevation in Arghish Dagh, 13,000 feet high, but the best known and most famous mountains of Anatolia are Mount Olympus and Mount Ida, overlooking the famous plains of Troy towards the Dardanelles. The Black Sea coast is rocky and contains but few harbours, but the west coast is very deeply indented.

The Ægean Archipelago

The plateau as a whole has severe winters, but the south and west coasts have mild winters and warm summers. Although the country is naturally fertile, agriculture is in a very backward state. Wheat, barley, millet and rice, however, are grown in various parts, and fruits such as the vine, olive, orange, lemon, apple, etc., are cultivated to a considerable extent. Forests of beech, oak, plane and other trees are found on the northern shores along the Black Sea coast. The islands of the archipelago in the Ægean Sea have a fine climate and produce much honey, fruit, wine and oil. Their names, Samothrace, Tenedos, Lemnos, Khios, Patmos, Rhodes, etc., are familiar in Biblical and classic literature.

The inhabitants of Anatolia are of mixed races, the Turkish predominating. Greeks and Armenians are the chief trading people, and the remainder of the inhabitants are made up of Arabs, Jews and Kurds.

Manufactures are few, though a little coal-mining is done, and silks, carpets, shawls, etc., are produced.

The chief ports of Anatolia are Trebizond and Sinope, on the Black Sea; Smyrna, on the Ægean; and Mersina, on the Mediterranean. There are about 3,000 miles of railways, which were formerly under German control.

Armenia

Armenia is as a term more a geographical expression than representing any definite political state, as the region so designated belongs in parts to Turkey, Russia and Persia.

It is for the most part a plateau of some 5,000 feet in average height, though it rises in Mount Massis to nearly 17,000 feet. It is in this plateau that the Tigris and Euphrates have their head streams, and it also contains two large lakes—Urmia and Van, both of them saline. The climate is more or less of the continental type, but the soil is very fertile, and large and important crops of grain, cotton and tobacco are grown.

The inhabitants of Armenia consist of Armenians, Kurds, Turks, Jews and Gipsies. The Armenians themselves are of the Caucasic group of peoples, and have a strongly developed commercial instinct. The most important towns in Armenia are Van, Erivan, Erzerum and Arabkir.

Syria is a name given to the Mediterranean coast region which stretches from the Arabian desert northward to Anatolia. The total area may be considered as about 120,000 square miles, of which 12,000 square miles are comprised in Palestine.

Syria is marked by two mountain ridges, the Lebanon and Anti Lebanon. These are distinct in the north, but form an upland region of irregular character in the south.

The climate depends mostly upon the elevation of the land, the higher slopes of the Lebanon being very cold, whereas in the Jordan valley the heat in summer is most oppressive. In Sharon and the Damascus district the vine, olive, mulberry, etc., flourish, and the Latakia tobacco of the district facing Cyprus is noted for its fine flavour. The Cedars of Lebanon are now almost non-existent.

Many of the famous cities which existed in Biblical times still flourish and are important even now. Damascus, Aleppo, Jerusalem, etc., are to-day among the chief centres of industry. Of sea ports there still exist Beyrut (Berytus), Tarabulus (Tripoli), and Latakia (Laodicea), besides Acre and Alexandretta (Iskanderun).

There are a few railways in Syria, and methods of communication have generally been much improved of late. The industries are mostly agricultural, cereals, fruit, cotton, etc., being cultivated, and a certain amount of wine made.

Arabia is the peninsula stretching southward from the Syrian desert between the Red Sea on the west and the Persian Gulf and the Gulf of Oman on the east into the Arabian Sea, one of the two great northern prolongations of the Indian Ocean. It has roughly an area of 1,250,000 square miles, with a scanty population of some 3,500,000.

Arabia is a great plateau with a mean elevation of 3,500 feet sloping steeply to the west and gently in other directions. The centre is composed of sandy desert, the low and fertile coastal strip existing between the highlands and the sea.

Photo: D. McLeish.

JERUSALEM.

A shepherd with his flock outside the Damascus Gate.

The inhabitants of Arabia are mostly Arabs, several of the tribes being practically independent.

The chief towns of Arabia are, in the Hejaz, Medina, Yambo (its port), and Mecca. In Yemen are Sana with its port Hodeida, from which are exported coffee and hides. In Oman is Muscat. The British possess Aden, as a coaling station and port, and the hinterland of about 9,000 square miles is under British protection.

PERSIA.—This country occupies the west-

ern part of the Iranian plateau, which extends from the Tigris valley to the highlands of Afghanistan. Its boundaries on the west and east are indefinite, but to the north it is bounded by the Caspian Sea and the Aralo-Caspian depression, and to the south by the Persian Gulf and the Gulf of Oman. Persia is on the whole very mountainous, but in the centre is the desert of Lut, which is actually an inland drainage system, though the streams which enter the desert usually dry up or form mere saline marshes.

The minerals, with which Persia is fairly well supplied, are of many kinds, but are worked only to a slight extent, with the exception of petroleum, which is now an important industry.

The capital of Persia is Teheran. There are a few railways but communications are still in an elementary stage. The population is about 10,000,000.

Persia, governed by the Shah, was formerly an absolute monarchy; but in 1906 a national council was established, since when it has had many vicissitudes.

Persian literature is celebrated especially for the writing of its poets, the chief of which are Jalalu'ddin, Sa'di, Omar Khayyám and Hafiz.

Afghanistan is a mountainous country on the north-west border of India. It forms a buffer state between Russian Asia and the British Empire in Asia, but is under British influence. The government is nominally an hereditary monarchy, the head of which is the Ameer, but the country is frequently in a state of turmoil, and often at war with Great Britain. The capital of Afghanistan is Kabul, with a population of 150,000, other important towns being Kandahar and Herat. The inhabitants are extremely mixed, and the industries are chiefly agricultural, though some carpets, silks and other fabrics are manufactured.

To complete our survey of Asia it only remains briefly to mention the East Indies, the most important of which belong to Holland, namely, Sumatra, Java, most of Borneo, Celebes and others too numerous to mention. Altogether these possessions cover an area of nearly 750,000 square miles. The capital is Batavia, on the island of Java.

The climate is uniformly hot and moist, and the products are those generally characteristic of the tropics, such as sugar, coffee, cacao, spices, tobacco, etc.

The inhabitants are mostly Malays, though there are many Chinese, Arabs and tribes native to the islands.

The Philippine Islands are the most important of the East Indies not belonging to Holland; they have been administered by the United States of America since 1898, when they were taken from Spain after the Spanish-American War.

Taken altogether the East Indies form a vast archipelago—the largest in the world, lying between China and Indo-China on the north and Australia on the south. They are generally mountainous and volcanic, the climate is often unhealthy, but they are very fertile and the scenery is wonderfully beautiful.

C. J. S.

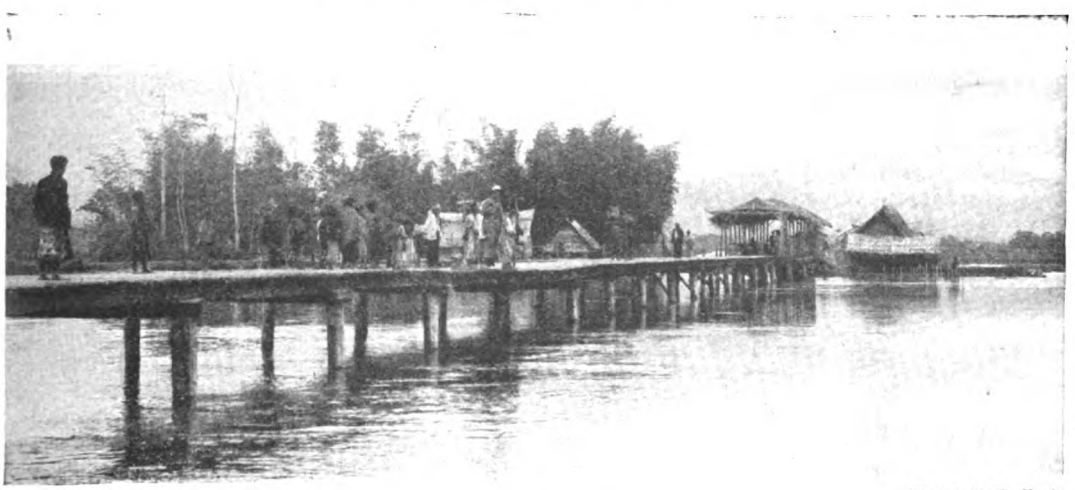


Photo: F. O. Koch.

SUMATRA,

an island belonging to Holland, is one of the most important of the East Indies. Above is shown the bridge approach to a village near Medan, the chief town on the east coast of the island.

Continued from page 285.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

MECHANICS.—XIII

76. Parallel Forces.

We have hitherto dealt with forces acting on a particle or on one point only of a body. We have now to deal with parallel forces which act at different points on an extended body.

We shall only deal with **rigid bodies,** i.e. bodies which do not alter their shape and size, and the particles of which consequently maintain their positions relative to one another unchanged.

Two forces acting at two points on a rigid body are in equilibrium if they are equal and opposite and *act in the same straight line.*

This may easily be verified experimentally by attaching two strings to a body at different points, and pulling the strings in opposite directions. The body will turn round until the strings are in one and the same straight line.

If a force act on a rigid body we may consider that its point of application lies anywhere in the straight line in which it acts.

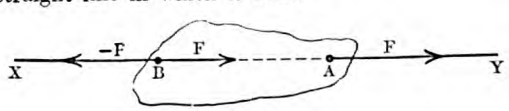


Fig. 59.

Suppose a force F to be applied to a point A in the body and to act in the line X Y. Take any other point B in the same straight line as X Y and apply to B two equal and opposite forces F acting in the line X Y. Now the force F at A and the force − F at B are in equilibrium since they are equal and opposite and act in the same straight line. Hence if we remove these two we are left with the force F at B as the equivalent of the force F at A.

77. Parallel forces are said to be **like** when they act in the same sense or direction; and **unlike** when they act in opposite senses.

To find the resultant of two like parallel forces.

Let P and Q be like parallel forces acting at A and B of the body, and let them be represented by the straight lines A L and B N.

Join A B and at A and B apply two equal and opposite forces F acting in directions B A and A B.

Let these be represented by A E and B G.

These two forces will be in equilibrium.

Complete the parallelograms A L M E and B N R G. Let the diagonals M A and R B produced meet at O. Draw O C parallel to P and Q to meet A B in C.

Then A M represents P_1, the resultant of P and F at A.

Let its point of application be moved to O.

Also B R represents Q_1, the resultant of Q and G at B.

Let its point of application be moved to O.

The force P_1 at O may be resolved into two forces, F parallel to A B acting in the sense B A and P along O C.

The force Q_1 at O may be resolved into two forces F parallel to A B acting in the sense A B and Q along O C.

The two forces F acting at O are in equilibrium.

Hence the original forces P and Q are equivalent

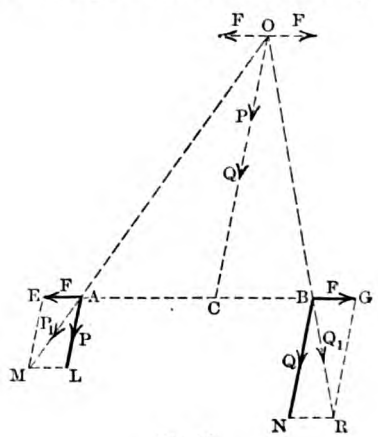


Fig. 60.

to a force (P + Q) acting at O along O C and therefore equivalent to a force (P + Q) acting at C in the direction O C, i.e. parallel to the original forces P and Q.

Now triangle O C A is similar to triangle A L M

$$\therefore \frac{OC}{CA} = \frac{AL}{LM} = \frac{P}{F} \therefore F \times OC = P \times CA$$

Similarly $F \times OC = Q \times CB$

$\therefore P \times CA = Q \times CB$

$\therefore CA : CB = Q : P$

Thus we have found as regards the resultant of two like parallel forces

(1) it equals in magnitude the sum of the forces.

(2) it acts in a direction parallel to the forces and in the same sense.

(3) it acts at a point in the straight line joining the points of application of the two forces, and this

point divides the straight line internally in the inverse ratio of the two forces.

78. *To find the resultant of two unlike parallel forces.*

Let P, Q be the forces, P being the greater, acting at A and B. At A and B apply two equal and opposite forces F (Fig. 61).

Construct the figure as in §77.

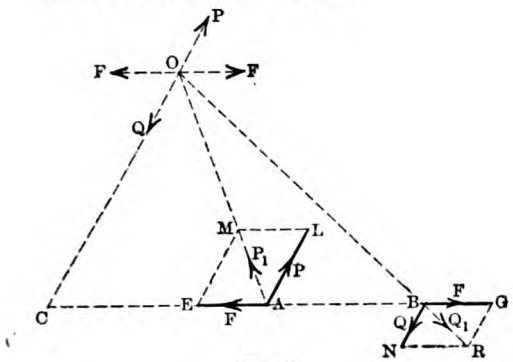


Fig. 61.

(The diagonals A M, R B will always meet unless they are parallel.)

Then A M represents the resultant P_1 of P and F.

Let its point of application be moved to O.

Also B R represents the resultant Q_1 of Q and F.

Let its point of application be moved to O.

Then the force P_1 at O may be resolved into the force F acting parallel to A B in the sense B A and the force P acting along O C in the sense C O.

Also the force Q_1 at O may be resolved into the force F acting parallel to A B in the sense A B and the force Q acting along O C in the sense O C.

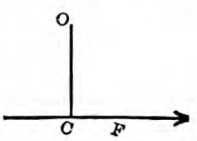


Fig. 62.

The two forces F acting at O are in equilibrium.

Hence the original forces P and Q are equivalent to a force (P − Q) acting at O parallel to P and Q, and therefore to a force (P − Q) acting at C parallel to P and Q.

Now triangle O C A is similar to triangle M E A

$$\therefore \frac{OC}{CA} = \frac{ME}{EA} = \frac{AL}{AE} = \frac{P}{F} \therefore OC \times F = CA \times P$$

Similarly $OC \times F = CB \times Q$

$\therefore CA \times P = CB \times Q$

$\therefore CA : CB = Q : P$

Hence as regards the resultant of two unlike parallel forces

(1) It equals in magnitude the difference of the forces.

(2) It acts in a direction parallel to these forces and in the same sense as the greater.

(3) It acts at a point in the straight line joining the points of application of the two forces, and this point divides the line externally in the inverse ratio of the forces.

Note that when the unlike parallel forces are equal the construction fails, since P_1 and Q_1 are then parallel. This case will be dealt with later. Such forces constitute a **couple.**

79. If we have a number of like parallel forces acting on a rigid body, we can find their resultant by a repeated application of the method of §77.

If we have a number of like or unlike parallel forces their resultant will clearly equal in magnitude the **algebraic** sum of the forces.

80. *Experimental verification of the resultant of two parallel forces.*

(1) *Like Forces.*

Take a light uniform rod X Y, suspended at its middle point C by a cord passing over a smooth pulley D. Let two masses weighing P and Q lb. respectively be suspended from points A and B.

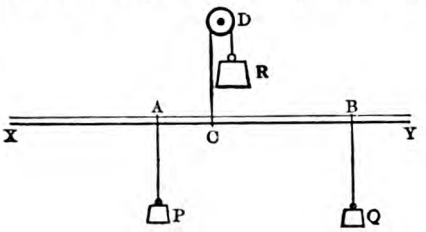


Fig. 63.

Then P and Q are two like forces. Attach a weight R = P and Q to the cord passing over the pulley D. Then shift the weights P and Q until the whole is in equilibrium, and it will be found that the distance C A is to the distance C B as Q is to P. So that $P \times CA = Q \times CB$.

The force R which is the equilibriant of P and Q, is equal and opposite to their resultant. Hence the resultant = R = P + Q and acts parallel to P + Q at a point C, such that $P \times CA = Q \times CB$.

(2) *Unlike Forces.*

As before let a mass P be suspended at A and let the mass Q be suspended on the cord passing over D. Then P and Q are two unlike forces. If Q is greater than P, then a weight $R^1 = Q - P$ will have to be suspended at some point B to maintain equilibrium, and it will be found that $P \times AB = Q \times CB$. Here again R^1 is equal and opposite to the resultant of P and Q.

81. **Forces tending to produce Rotation. Moments.**—*The moment of a force about a given point is the product of that force and the perpendicular drawn from the point on to the line of action of the force.*

Suppose a force F be acting on a body. Then the moment of F about the point O is F × O C, where O C is the perpendicular from O on to the line of action of F (Fig. 62).

Now clearly if the body be fixed at O, and the force F act as in the figure, the body will tend to rotate round an axis passing through O perpendicular to the plane in which the force acts. Suppose we wish to shut a door, hinged at one side, we give it a push, perpendicular to the plane of the door. It is a matter of common experience that if we push the door near the hinge, we must exert far more force than if we give it a push near the edge farthest from the hinges. In fact, the farther from the line of hinges the push is, the less the force required. The product of the force required to move the body and the perpendicular distance of its line of action from the axis of rotation is constant in each

particular case, and this is what we term the moment of a force.

In the accompanying figures the force F tends to make the body rotate round O in a counter clockwise direction. The moment of such a force is called **positive.** On the other hand the force F^1

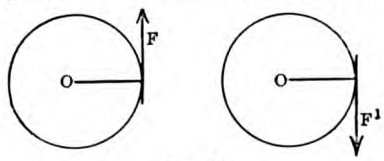


Fig. 64.

tends to make the body rotate round O in a clockwise direction. The moment of such a force is called **negative** (Fig. 64).

In forming the algebraic sum of moments, the proper sign for each moment must be taken into account.

82. *Geometrical representation of the moment of a force.*

Suppose A B represent the force F in magnitude and direction, and O be any fixed point and O N the perpendicular from O to A B or A B produced.

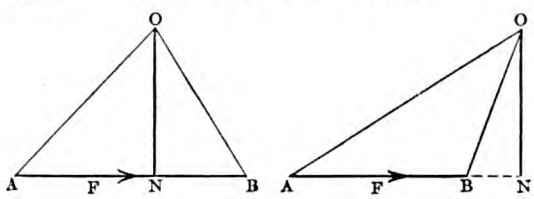


Fig. 65.

Then the moment of F about O = F × O N = A B × O N = twice area of triangle A O B.

Hence the moment of a force about a point is represented by twice the area of the triangle whose vertex is the point and whose base is the straight line representing the force in magnitude and direction.

If a force F *be applied at any point* A, *its moment about a given point* O *is the product of* O A and the resolved part of F perpendicular to O A.

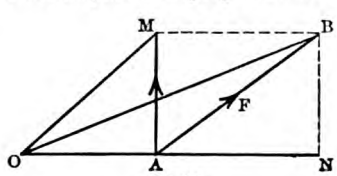


Fig. 66.

Let A B represent the force F. Complete the rectangle A N B M, the side A N being a continuation of O A (Fig. 66).

Then A N and A M are the components of F resolved along O A and perpendicular to O A.

Now triangle A O B = triangle A O M in area.

And the moment of F about O = twice triangle O A B = twice triangle A O M = O A × A M = O A × resolved part of F perpendicular to O A.

83. *The moments of two intersecting forces about any point in the line of action of their resultant are equal and opposite.*

Let the forces P and Q act along A B, A C and let A D be any point in the line of action of their resultant R.

Let A B represent P in magnitude as well as direction. Complete the parallelogram A B D C.

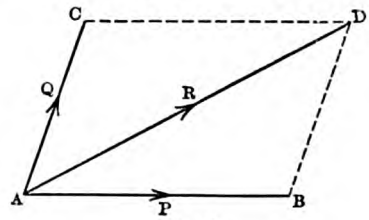


Fig. 67.

Then on the same scale A C and A D represent the forces Q and R.

Now triangle A B D represents half the moment of P about D,

and triangle A C D represents half the moment of Q about D.

And triangle A B D = triangle A C D.

∴ moment of P about D = moment of Q about D.

Also these moments tend to turn the body about D in opposite directions,

i.e. they are equal and opposite.

84. *The algebraic sum of the moments of any two forces about any point in their plane is equal to the moment of their resultant about that point.*

CASE 1.—*Let the forces intersect.*

Let P and Q be two forces acting at the point A, and let O be the point about which moments are

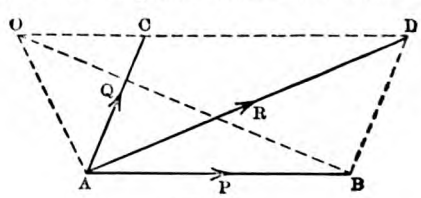


Fig. 68.

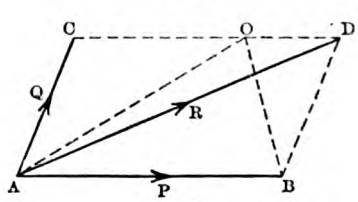


Fig. 69.

taken. Draw O C parallel to the direction of P to meet the line of action of Q in C.

Let A C represent Q in magnitude and complete the parallelogram A C D B.

Then on the same scale, A B, A D represent P and R in magnitude, R being the resultant of P and Q.

Fig. 68.—O lies *without* the triangle D A C.

Then the moments of P and Q about O are all in the same direction, hence we must show that twice triangle O A B and twice triangle O A C = twice triangle O A D.

Now triangle O A B = triangle D A B = triangle A C D.

$\therefore$ 2 triangle O A B + 2 triangle O A C
= 2 triangle A C D + 2 triangle O A C = 2 triangle A O D.

Fig. 69.—O lies within the angle D A C.

Then the moment of P and Q about O are in opposite directions, hence we must show that 2 triangle O A B − 2 triangle O A C = 2 triangle O A D.

Now triangle O A B = triangle D A B = triangle A C D

$\therefore$ 2 triangle O A B − 2 triangle O A C.
= 2 triangle A C D − 2 triangle O A C = 2 triangle A O D.

CASE 2.—*Let the forces be parallel.*

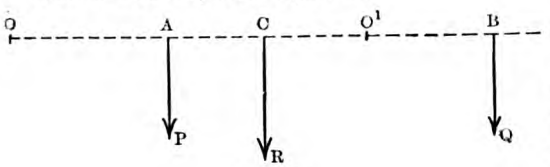


Fig. 70.

Let P and Q be two parallel forces and R = P + Q their resultant (Fig. 70).

Let O be the point about which moments are to be taken. Through O draw a line perpendicular to the lines of action of P, Q and R, let it cut these lines of action in A, B and C respectively.

Then P × A C = Q × C B

$\therefore$ th sum of the moment of P and Q about O
= P × O A + Q × O B = P (O C − A C) + Q (O C + C B)
= (P + Q) O C − P × A C + Q × C B = (P + Q) × O C = R × O C
= moment of R about O.

If O lies between A and B at O^1, then the moments of P and Q about O^1 are in opposite directions.

Then the algebraic sum of the moments of P and Q about O^1 = P × O^1 A − Q × O^1 B
= P (O^1 C + C A) − Q (C B − O^1 C)
= (P + Q) O^1 C − P × C A − Q × C B
= (P + Q) × O^1 C = R × O^1 C = moment of R about O^1.

85. *If any number of forces in one plane acting on a rigid body have a resultant, the algebraic sum of their moments about any point in their plane is equal to the moment of their resultant about that point.*

Let the forces be P, Q, S, T, ... and let O be the point about which moments are taken.

Let R_1 be the resultant of P and Q
let R_2 be the resultant of R_1 and S
let R_3 be the resultant of R_2 and T
and so on until the final resultant is reached.

Then the moment of R_1 about O = sum of moments of P and Q about O (§ 83).

Again the moment of R_2 about O
= sum of moments of R_1 and S about O.
= sum of moments of P, Q and S about O
and so on.

Hence the moment of the final resultant about O = algebraic sum of the moments of the component forces about O.

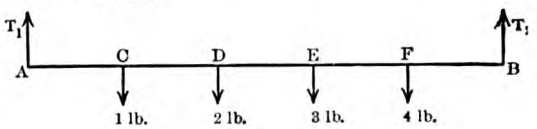
Corollary 1. If any number of coplanar forces acting on a rigid body are in equilibrium, the algebraic sum of their moments about any point in the plane vanishes.

For since the forces are in equilibrium, their resultant is zero, therefore its moment about any point is zero, and hence the algebraic sum of the moments of the component forces is zero.

Corollary 2. If the algebraic sum of the moments of any number of coplanar forces about a point O in the plane vanishes, then either the forces are in equilibrium or the point O lies on the line of action of their resultant.

Example:

A weightless rod 5 feet long supported by two vertical strings attached to its ends, has weights of 1, 2, 3 and 4 lb. hung on to it at distances of 1, 2, 3 and 4 feet from one end. What are the tensions on the strings?



Let T_1 and T_2 be the tensions in the strings. Let A B be the rod, and C, D, E, F the points from which the weights are hung.

The forces are in equilibrium, therefore their resultant = 0 and therefore its moment about the point A = 0

$\therefore$ the algebraic sum of the moments of all the forces about A = 0

$\therefore 1 \times 1 + 2 \times 2 + 3 \times 3 + 4 \times 4 - T_2 \times 5 = 0$

$\therefore T_2 = \frac{31}{5}$ lb. wt. = 6·2 lb. wt.

Similarly taking moments about B

$T_1 \times 5 - 1 \times 4 - 2 \times 3 - 3 \times 2 - 4 \times 1 = 0$

$\therefore T_1 = \frac{20}{5}$ lb. wt. = 4 lb. wt.

Exercise 14

(1) Find the resultants of the following pairs of like parallel forces.
(*a*) 12 lb. and 4 lb., 8 ft. apart.
(*b*) 10 lb. and 15 lb., 5 ft. apart.
(*c*) 4 gms. and 16 gms., 180 cm. apart.
(2) Find the resultants when the above forces are unlike.

Key to Exercise 13

(1) 20, $20\sqrt{2}$, $20\sqrt{3}$, $20(2+\sqrt{2})$, $20(2+\sqrt{3})$ lb. cwt.
(2) Each = $6\sqrt{2}$ lb. wt. (3) 45 lb. wt. (4) 3 lb. wt. (5) $12\sqrt{3}$ lb. wt. (6) $\frac{\sqrt{3}}{3}w$, $\frac{\sqrt{2}}{2}w$, w, where w = weight of the picture.

The best way with a single cord is to hang it on two nails as far apart as the eyes on the picture.

(9) 11·1 lb. nearly. (10) 400 lb. wt. (11) $100\sqrt{3}$ lb. wt. (12) 2500 lb. wt. (13) Tension = 225 lb., pressure = 135 lb.

(14) $28\sqrt{2}$ lb. wt. Tension would equal weight if the cords were inclined at an angle of 30° to the horizontal, and would be greater than the weight if the cords were inclined at an angle to the horizontal less than 30°. M. A. L.

TRIGONOMETRY.—VII

60. Relations between the elements of a triangle.

If A B C be any triangle, we denote the angles by A, B and C, and the lengths of the sides opposite these angles by a, b and c respectively.

There are certain facts we know which it is desirable to recall.

(1) $A + B + C = 180°$.

If A be any angle of a triangle it lies between 0° and 180° (i.e. $0° < A < 180°$) and consequently

(2) sin A is positive and either sin $A = 1$ or sin $A < 1$ numerically.

(3) cos A may be positive or negative, and cos $A = 1$ or cos $A < 1$ numerically.

(4) tan A may have any value whatever, positive or negative.

(5) If we are given the value of sin A, there are two angles which have this given positive value for their sine; both are $< 180°$, but one is $< 90°$ and the other is $> 90°$.

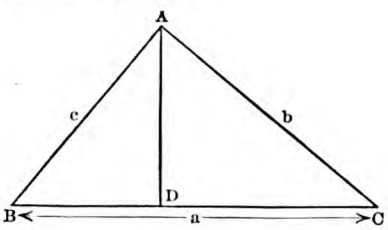


Fig. 1.

(6) If we are given the value of cos A or of tan A, there is only one angle in each case which has the given value (positive or negative) for its cosine or its tangent, as the case may be.

(7) $\frac{A}{2} + \frac{B}{2} + \frac{C}{2} = 90° \therefore \frac{A}{2} < 90°$ and $\therefore$ all the trigonometrical ratios of $\frac{A}{2}$ are positive, and $\frac{A}{2}$ is known if the value of any one of these ratios is given.

The above apply equally to the angles B and C.

61. *In any triangle* $a = b \cos C + c \cos B$.

Let A B C be any triangle. There will be three cases.

Case 1. $\triangle$ A B C is acute angled (Fig. 1) $<$ C acute.

Case 2. $\triangle$ A B C is obtuse angled (Fig. 2) $<$ C obtuse.

Case 3. $\triangle$ A B C is right angled (Fig. 3) $<$ C right $\angle$.

Draw A D $\perp$ to B C.

Fig. 1. $\frac{C D}{C A} = \cos A C B$ i.e. $C D = b \cos C$.

$\frac{D B}{B A} = \cos A B C$ i.e. $D B = c \cos B$

$\therefore a = B C = C D + D B = b \cos C + c \cos B$

Fig. 2. $\frac{C D}{C A} = \cos A C D = \cos (180° - A C B)$

$= \cos (180° - C) = - \cos C$.

$\therefore C D = - b \cos C$.

$\frac{B D}{B A} = \cos A B C \therefore B D = c \cos B$.

$\therefore a = B C = B D - C D = c \cos B - (- b \cos C)$

$= b \cos C + c \cos B$.

Fig. 3. $\frac{B C}{B A} = \cos C \therefore a = B C = c \cos B$.

Now $b \cos C = b \cos 90° = 0$ (since $\cos 90° = 0$)

$\therefore a = b \cos C + c \cos B$.

Similarly $b = c \cos A + a \cos C$.

and $c = a \cos B + b \cos A$.

Corollary. If d, e, f denote the perpendiculars from A, B and C *on to* B C, C A *and* A B *respectively*

Then $2d = b \sin C + c \sin B$.

$2e = c \sin A + a \sin C$.

$2f = a \sin B + b \sin A$.

62. *In any triangle, the sides are proportional to the sines of the opposite angles.*

Using the figures in § 61.

Fig. 1. A D $= b \sin C$ also A D $= c \sin B$

$\therefore b \sin C = c \sin B$

$\therefore \frac{b}{\sin B} = \frac{c}{\sin C}$

Fig. 2. A D $= c \sin B$.

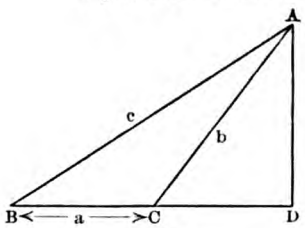


Fig. 2.

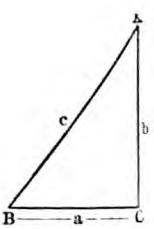


Fig. 3.

Also A D $= b \sin A C D = b \sin (180° - C)$ $= b \sin C$.

$\therefore c \sin B = b \sin C$.

$\therefore \frac{b}{\sin B} = \frac{c}{\sin C}$.

Fig. 3. A C $= c \sin B$ i.e. $b = c \sin B$

$\therefore b \sin C = c \sin B$ (since $\sin C = \sin 90° = 1$)

$\therefore \frac{b}{\sin B} = \frac{c}{\sin C}$.

Similarly it may be shown that $\frac{a}{\sin A} = \frac{b}{\sin B}$

$\therefore \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$.

63. *To express the cosines of the angles of any triangle in terms of the sides.*

Using the figures of § 61.

Fig. 1. $A B^2 = A C^2 + B C^2 - 2 B C . C D$.

i.e. $c^2 = b^2 + a^2 - 2a . C D$.

Now $C D = b \cos C$

$\therefore c^2 = b^2 + a^2 - 2a b \cos C$

$\therefore 2a b \cos C = a^2 + b^2 - c^2$

i.e. $\cos C = \frac{a^2 + b^2 - c^2}{2a b}$

Fig. 2. $A B^2 = A C^2 + B C^2 + 2 B C . C D$

i.e. $c^2 = b^2 + a^2 + 2a C D$.

Now $C D = b \cos A C D = b \cos (\pi - C) = - b \cos C$

$\therefore c^2 = b^2 + a^2 - 2 a b \cos C$

i.e. $\cos C = \frac{a^2 + b^2 - c^2}{2 a b}$.

Fig. 3. $A B^2 = A C^2 + B C^2$

i.e. $c^2 = b^2 + a^2$

$\therefore c^2 = b^2 + a^2 - 2ab \cos C$ (since $\cos C = \cos 90° = 0$)

$\therefore \cos C = \dfrac{a^2 + b^2 - c^2}{2ab}$.

Similarly $\cos B = \dfrac{c^2 + a^2 - b^2}{2ca}$

and $\cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$.

64. *To find the cosines of the semiangles of a triangle in terms of the sides.*

We know that $2\cos^2 \frac{A}{2} = 1 + \cos A$

$\therefore 2\cos^2 \frac{A}{2} = 1 + \dfrac{b^2 + c^2 - a^2}{2bc}$

$= \dfrac{2bc + b^2 + c^2 - a^2}{2bc} = \dfrac{(b + c)^2 - a^2}{2bc}$

$= \dfrac{(b + c - a)(b + c + a)}{2bc}$.

Now let the perimeter of the triangle, viz. $a + b + c$, $= 2s$, then $b + c - a = 2s - 2a$

$\therefore \cos^2 \frac{A}{2} = \dfrac{2s \cdot 2(s - a)}{4bc} = \dfrac{s(s - a)}{bc}$

$\therefore \cos \frac{A}{2} = \sqrt{\dfrac{s(s - a)}{bc}}$ (we take the positive root only, remembering that $\cos \frac{A}{2}$ must be positive).

Similarly $\cos \frac{B}{2} = \sqrt{\dfrac{s(s - b)}{ca}}$ and $\cos \frac{C}{2}$

$= \sqrt{\dfrac{s(s - c)}{ab}}$.

65. *To express the sines of the semiangles of a triangle in terms of the sides.*

$2\sin^2 \frac{A}{2} = 1 - \cos A = 1 - \dfrac{b^2 + c^2 - a^2}{2bc}$

$= \dfrac{2bc - b^2 - c^2 + a^2}{2bc} = \dfrac{a^2 - (b - c)^2}{2bc}$

$= \dfrac{(a + b - c)(a - b + c)}{2bc}$

$\therefore \sin^2 \frac{A}{2} = \dfrac{2(s - c) \cdot 2(s - b)}{4bc} = \dfrac{(s - c)(s - b)}{bc}$

$\therefore \sin \frac{A}{2} = \sqrt{\dfrac{(s - b)(s - c)}{bc}}$.

Similarly $\sin \frac{B}{2} = \sqrt{\dfrac{(s - c)(s - a)}{ca}}$ and $\sin \frac{C}{2}$

$= \sqrt{\dfrac{(s - a)(s - b)}{ab}}$.

66. *To find the tangents of the semiangles of a triangle in terms of the sides.*

$\tan \frac{A}{2} = \dfrac{\sin \frac{A}{2}}{\cos \frac{A}{2}} = \dfrac{\sqrt{\frac{(s - b)(s - c)}{bc}}}{\sqrt{\frac{s(s - a)}{bc}}}$

$= \sqrt{\dfrac{(s - b)(s - c)}{s(s - a)}}$.

Similarly $\tan \frac{B}{2} = \sqrt{\dfrac{(s - c)(s - a)}{s(s - b)}}$ and $\tan \frac{C}{2}$

$= \sqrt{\dfrac{(s - a)(s - b)}{s(s - c)}}$.

67. *To express the sines of the angles of a triangle in terms of the sides.*

$\sin A = 2\sin \frac{A}{2} \cdot \cos \frac{A}{2}$

$= 2\sqrt{\dfrac{(s - b)(s - c)}{bc}} \cdot \sqrt{\dfrac{s(s - a)}{bc}}$

$= \dfrac{2}{bc}\sqrt{s(s - a)(s - b)(s - c)}$.

The expression $\sqrt{s(s - a)(s - b)(s - c)}$ is usually denoted by S.

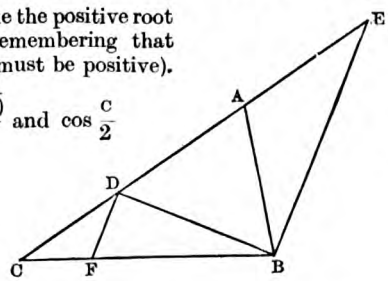
$\therefore \sin A = \dfrac{2S}{bc}$; similarly $\sin B = \dfrac{2S}{ca}$ and $\sin C$

$= \dfrac{2S}{ab}$.

Also $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C} = \dfrac{abc}{2S}$.

68. *To prove that in any triangle* $\tan \frac{B - C}{2}$

$= \dfrac{b - c}{b + c} \cot \frac{A}{2}$.



(1) *Algebraic proof.*

We know that the sides of the triangle are proportional to the sines of the opposite angles.

$\therefore \dfrac{b - c}{b + c} = \dfrac{\sin B - \sin C}{\sin B + \sin C}$

$= \dfrac{2\cos \frac{B + C}{2} \cdot \sin \frac{B - C}{2}}{2\sin \frac{B + C}{2} \cdot \cos \frac{B - C}{2}} = \cot \frac{B + C}{2} \cdot \tan \frac{B - C}{2}$

$\therefore \tan \frac{B - C}{2} = \dfrac{b - c}{b + c} \tan \frac{B + C}{2}$

$= \dfrac{b - c}{b + c} \cot \left(90° - \frac{B + C}{2}\right) = \dfrac{b - c}{b + c} \cot \frac{A}{2}$.

Similarly $\tan \frac{C - A}{2} = \dfrac{c - a}{c + a} \cot \frac{B}{2}$

and $\tan \frac{A - B}{2} = \dfrac{a - b}{a + b} \cot \frac{C}{2}$.

(2) *Geometrical proof.*

Let ABC be a triangle. From AC and CA produced cut off AD, AE equal to AB. Join BE and draw DF $\perp$ to BD cutting BC in F.

Then DBE is a right angle.

$\therefore$ BE is parallel to FD.

Now $\angle ABD = \angle ADB = \frac{1}{2}\angle BAE = \dfrac{B + C}{2}$

and $\angle DBC = \angle ADB - \angle ACB = \dfrac{B + C}{2} - C$

$= \dfrac{B - C}{2}$.

Also $\frac{b-c}{b+c} = \frac{CD}{CE} = \frac{DF}{EB} = \frac{DF}{DB} \times \frac{DB}{EB}$

$= \tan\frac{B-C}{2} \cdot \cot\frac{B+C}{2} = \tan\frac{B-C}{2} \cdot \tan\frac{A}{2}$

$\therefore \tan\frac{B-C}{2} = \frac{b-c}{b+c}\cot\frac{A}{2}$.

69. The student is recommended to learn these formulæ which we have just proved, and of which we append a list:

$a = b\cos C + c\cos B$

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = \frac{abc}{2S}$

$\cos A = \frac{b^2+c^2-a^2}{2bc}$

$\cos\frac{A}{2} = \sqrt{\frac{s(s-a)}{bc}}$

$\sin\frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{bc}}$

$\sin A = \frac{2}{bc}\sqrt{s(s-a)(s-b)(s-c)} = \frac{2S}{bc}$

$\tan\frac{B-C}{2} = \frac{b-c}{b+c}\cot\frac{A}{2}$.

70. Examples:—

(1) We may deduce the expression for the cosine of an angle of a triangle in terms of its sides, from the formulæ $a = b\cos C + c\cos B$, etc.

We have

$a = b\cos C + c\cos B$ ..... (i)

$b = c\cos A + a\cos C$ ..... (ii)

$c = a\cos B + b\cos A$ .....(iii).

Multiply (i) by a, (ii) by b and (iii) by c and subtract the first from the sum of the second and third; then

$b^2 + c^2 - a^2 = bc\cos A + ab\cos C + ac\cos B + bc\cos A - ab\cos C - ac\cos B$

$= 2bc\cos A$

$\therefore \cos A = \frac{b^2+c^2-a^2}{2bc}$.

(2) Having given that the sides of a triangle are proportional to the sines of the opposite angles, we may deduce the expression for the cosine of an angle in terms of the sides

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$.

Let each of these equal d

then $a = d\sin A$, $b = d\sin B$ and $c = d\sin C$.

Then $\frac{b^2+c^2-a^2}{2bc} = \frac{d^2(\sin^2 B + \sin^2 C - \sin^2 A)}{2d^2\sin B\sin C}$

$= \frac{\sin^2 B + \sin^2 C - \sin^2 A}{2\sin B \cdot \sin C}$

$= \frac{\frac{1}{2}(1 - \cos 2B + 1 - \cos 2C) - \sin^2 A}{2\sin B\sin C}$

$= \frac{\frac{1}{2}\{2 - 2\cos(B+C)\cos(B-C)\} - \sin^2 A}{2\sin B\sin C}$

$= \frac{1 + \cos A\cos(B-C) - \sin^2 A}{2\sin B\sin C}$

$= \frac{\cos A\{\cos(B-C) + \cos A\}}{2\sin B \cdot \sin C}$

$= \frac{\cos A\{\cos(B-C) - \cos(B+C)\}}{2\sin B\sin C}$

$= \frac{\cos A \cdot 2\sin B \cdot \sin C}{2\sin B \cdot \sin C} = \cos A$.

Exercise 14

In any triangle A B C prove the following:—

(1) $\frac{\sin^2 A - m\sin^2 B}{a^2 - mb^2} = \frac{\sin^2 C}{c}$.

(2) $\frac{\cos A}{\sin B\sin C} + \frac{\cos B}{\sin C\sin A} + \frac{\cos C}{\sin A\sin B} = 2$.

(3) $(b+c)\cos A + (c+a)\cos B + (a+b)\cos C = a + b + c$.

(4) $a\left(\sin^2\frac{B}{2} + \sin^2\frac{C}{2}\right) + b\left(\sin^2\frac{C}{2} + \sin^2\frac{A}{2}\right) + c\left(\sin^2\frac{A}{2} + \sin^2\frac{B}{2}\right)$

$= \frac{1}{2}(a + b + c)$.

(5) $\frac{\tan B}{\tan C} = \frac{a^2 + b^2 - c^2}{a^2 - b^2 + c^2}$.

(6) If D is the middle point of B C, show that $4AD^2 = 2b^2 + 2c^2 - a^2$.

(7) If D, E, F are the middle points of B C, C A, A B respectively, show that

$4(AD^2 + BE^2 + CF^2) = 3(a^2 + b^2 + c^2)$.

(8) If d, e, f are the perpendiculars from A, B and C respectively on the opposite sides, then

$a\sin A + b\sin B + c\sin C = 2(d\cos A + e\cos B + f\cos C)$.

(9) If $A = 3B$ then $\sin B = \frac{1}{2}\sqrt{\frac{3b-a}{b}}$.

(10) If $a = \sqrt{5}$, $b = 2$, $c = \sqrt{3}$, then $8\cos A\cos C = 3\cos B$.

(11) Find the cosines and sines of the semiangles of a triangle whose sides are 3, 4 and 5.

(12) The sides of a triangle are 2, $\sqrt{2}$ and $\sqrt{3} - 1$. Find its angles.

(13) If $B = 15°$ and $C = 30°$, show that $a = c\sqrt{2}$.

(14) If a, b, c be in arithmetic progression, show that $3\tan\frac{A}{2} \cdot \tan\frac{C}{2} = 1$.

(15) If A B C D be a quadrilateral, then $AB\cos A - BC\cos(A+B) + CD\cos D = AD$ and $AB\sin A - BC\sin(A+B) - CD\sin D = 0$.

(16) Show that

$sS = abc\cos\frac{A}{2} \cdot \cos\frac{B}{2}\cos\frac{C}{2}$.

(17) If $(a^2 + b^2)\cos 2A = b^2 - a^2$, then either the triangle is right angled, or two of its angles differ by a right angle.

(18) If D is any point in the side A B of a triangle A B C, such that $AD : DB :: m : n$, then if $\angle CDB = \delta$, show that $(m+n)\cot\delta = n\cot A - m\cot B$.

Key to Exercise 12

(11) $n\pi \pm \frac{\pi}{10}$; $n\pi \pm \frac{3\pi}{10}$. (12) $n\pi$; $n\pi \pm \frac{\pi}{6}$.

(13) $n\pi + (-1)^n\frac{\pi}{6}$; $n\pi + (-1)^n\frac{\pi}{10}$; $n\pi - (-1)^n\frac{3\pi}{10}$.

Key to Exercise 13

(1) 7 ft. 6 in. (2) 82 ft. 2 in. (3) $\frac{\sqrt{3}}{4}$ miles.

M. A. L.

Continued from page 288.

ART AND MUSIC:

Contributors **:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O. ; Hubert Grant).**

MUSIC.—X

ALTHOUGH no royal road to the general acquirement of great skill in piano-playing has been discovered—nor is one likely to be discovered, seeing that our physical qualifications are unequal, whilst the instrument and the music are the same for every one—each of us that desires has, happily, the practical certainty of becoming a quite respectable performer if we will go about the business in the right way and take the necessary pains. And it seems common sense that we ought at the start to know a little about the instrument the proper use of which we are setting out to learn.

The Pianoforte—

In speaking of the pianoforte we have ordinarily in mind the familiar instrument which, under the name of the "cottage" piano, represents the popular idea for private use and practice. The dimensions of this instrument vary a little with different makers, but an average size is about 4 ft. 6 in. in height, 4 ft. 2 in. in length, and 2 ft. 2 in. in width. A smaller instrument, called the "piccolo" piano, very compact and admirable, is manufactured for use where space is very restricted.

The "cottage" style of piano was first introduced about a century ago. For long previous to that only "grands" and the "square" (or "table") piano had been known. Then it occurred to someone to stand the grand on end, raise this some distance from the ground, and arrange the keyboard so that it could be played from the lower part.

The next step thought of was to bring the frame down to the floor, which was the idea of an Englishman living in Philadelphia; and so the "upright grand," much reduced in height, became the "cottage." But the instrument was still inconveniently high; and the modifications and improvements which enabled nearly a couple of feet to be taken off its altitude were not effected for a good many years.

Previous to the invention of the particular method of vibrating the strings or wires, which distinguishes the pianoforte from other clavier instruments—viz., by springing against the wire a small covered hammer-head, separate from the finger-key—a number of instruments in which the strings were acted upon directly by keys had been constructed, and were popular at one time.

—A Development of the Monochord

They were all developments, of course, of the ancient monochord (or monachord). When it was found that by inserting bridges at certain points of the monochord, two or even three sounds could be got from the one string divided into lengths, the way was clear to add more strings and get more notes. The keys of the organ furnished another idea, and by Chaucer's time the young ladies who were learning the "Prenche of Stratforde-atte-Bowe," were also taking lessons on the "monachord."

From the monachord there developed the clavichord, in which strings of gut or brass wire were struck from underneath by a little wedge of metal at the end of a finger-key. This long-popular instrument, though its light single wires gave only a small tone, was eventually made so excellently and responded so admirably to the touch of a finished player that John Sebastian Bach, who lived till 1750 (forty years after the invention of the piano), himself preferred the equal-tempered clavichord (for which he wrote his famous Preludes and Fugues) to the pianos and harpsichords of his day.

By the side of the clavichord there grew up during the centuries another instrument, also of the clavier kind, which was known as the Virginal, or "Virginals," the name suggesting that the art of performance upon it was presumably the domain of the fair

sex. The Virginal was radically different from the clavichord in the fact that its strings were clipped or twanged by a little plectrum, or point, of shell, metal, leather, or quill. This was so arranged at the end of the finger-key that, after the string had been scratched or twanged, and the key was released, the plectrum-holder would move on a centre and slip easily back to position under the string.

Queen Elizabeth is credited with having been a skilful player upon the Virginal, the music for which, as for the Spinet, which

HANDEL'S HARPSICHORD,

now preserved in the S. Kensington Museum, has two keyboards. The top row operates single strings for soft and dainty passages ; whilst the bottom keyboard has two strings to each note, and stops to couple up other strings.

succeeded it, was remarkable for the nimbleness of execution required. Broad harmonies and chord passages were then unknown, and the performers did not use the thumb.

The Spinet, a large instrument of the Virginal class, like a harp laid flat, is believed to have been the invention of an Italian named Giovanni Spinetta, of Venice. There are in existence in museums specimens of Spinets dating from reigns even prior to Elizabeth.

The Spinet was an instrument without legs, originally, and had to be placed upon a table. Its increased tone-power directed attention to possibilities in this direction, and it was not long before the Harpsichord came into existence. This was the culmination of advance in the direction of clavier and plectrum-twanged strings, little quills generally being used to pluck the wire.

The Harpsichord was an instrument greatly favoured by musicians in England in the first half of the eighteenth century, due a good deal to the fact that Handel (died 1759, aged 74) was a great performer upon it. Handel, a Hanoverian, and *protégé* of the Elector who became George I. of England, had great political support against the Marlborough party—who in the world of fashionable music were represented by the Italian school of Bononcini, Porpora, etc.

Bononcini and Handel

If Bononcini—who was invited to this country to try to "cut out" Handel—had been a master of the pianoforte instead of the 'cello, the Italian clavier instrument might have become better known in England. As it fell out, however, the harpsichord—which was really a magnificent piece of work and capable of exquisite results in the hands of a master—retained a leading place in this country till well on towards 1800.

An instrument in the South Kensington Museum which once belonged to Handel has two rows of keys, or, rather, two keyboards, arranged like organ manuals. The upper row operates single strings, for soft and dainty passages, whilst the bottom keyboard has two strings to each note and stops to couple up other strings. The difficulty with such instruments must have been to keep them in tune.

They were further complicated by having devices to enable the special quality of tone of other instruments to be imitated, such as the bassoon and violin, or the lute, in which secondary strings vibrated in sympathy with those plucked. The principle of the "venetian blind," to gently shut off the sound, or allow it to steal out, or to burst suddenly forth, was introduced; but the real desideratum—the clear ringing, loud sound, with vibrational warmth, and its contrast of gentle softness at the end of the finger—was not possible with the harpsichord.

The invention of the pianoforte, of which the mechanism by means of which the string is sounded was the main feature, is claimed for an Italian named Christoforo, a maker of harpsichords, who carried on business in both Padua and Florence.

Other people took up the idea, which had come to Christoforo, of a detached hammer flicked by a blow from the finger-key against the string, and falling back by its own weight into a resting position before the pressure on the key even was removed.

Christoforo died and left behind him only a disputed record, but German firms exist to-day which copied his idea and his instrument. It was one of those inspirations which, occurring now and then to gifted individuals, revolutionise the world's affairs in particular directions.

Variety of Tone

The secret of flexibility and rapidity of stroke, combined with every gradation of tone, from the tinkle of fairy-bells to Borwick playing a transcribed organ fugue, Paderewski's extraordinary sustained legato, and Godowsky's sensational staccato passages—all lay in Christoforo's rudimentary idea, for which the world had waited since stringed instruments were first invented.

The carrying of the invention farther—the proper "damping" or stopping, the vibration of the string, the bichords, the trichords, the pedals, the "check" action, which allows the hammer to come to rest so beautifully close to the string without touching it, the delightful ease of repetition, and, of course, the very suitable shape of the domestic piano and its moderate price—all are matters that have occupied the ingenuity, time, and patience of innumerable clever men—scientists, musicians, instrumentalists, mechanicians, and business people during a century and a half or more.

Well, now, we have got our piano; we have been interested in its ancestry; behind that polished front lie the hammers and strings with the reciprocal action of which we are now familiar; we have learned—is it not so?—that music is worth troubling about, that it has something to give us in return for our trouble; and the determination has been awakened to do something.

Get a teacher, if you can;. the very best you can afford; and, old or young, do as you are instructed.

The advanced student, of course, has long ago done this; the serious beginner must act on the advice. That is the only way to avoid pitfalls, and not to acquire bad habits which later would be extremely difficult to unlearn; such as your position at the piano and use of the arm, wrist and fingers.

Are there no "short cuts," then, you may ask, nothing that you can do "on your own"?

Yes, certainly, there are a few short cuts on the road, that you may take; and there are hints, suggestions and facts, some of which are perhaps beyond the powers of even the good teacher to impart. These are doubly valuable, as they are the fruit of one's own intelligent application. H. G.

From the portrait by Sir James Thornhill, in the Fitzwilliam Museum, Cambridge.

GEORGE FREDERICK HANDEL (1685–1759).

FORTUITOUS DECORATION

It is a commonplace that the most successful efforts in almost any relation of life come very often by accident. Great artists and great writers frequently are unaware of their best work. It is probable that Thackeray had no notion of what he was doing when he created Becky Sharp; and the genius of many notable painters must have been equally unconscious. But it is curious to notice sometimes how things arrange themselves beautifully by chance, without the slightest intention on the part of the person whose hands have touched them.

Here is a small instance as a result of which a quite admirable painting of still life was made, but which, whether painted or not, made a pleasant impression for the moment upon the mind of the painter.

Clash of Colours

There was a table against the wall covered with a dark blue cloth. On it was a sheet of white blotting paper. By the side of that a quill pen and in front of it a simple glass ink-pot full of ordinary blue ink. But at some previous time a heavy blot of red ink had come on the blotting paper and this was reflected with almost exaggerated intensity on the side of the ink-pot. The wall behind the table was of a pale biscuit colour, and there appears in the still-life picture that was painted the lower half of a narrow gold frame with a white margin. The water-colour sketch which the frame contained does not appear at all—only the sheen of the glass.

That is absolutely all, both in the picture and in the arrangement of objects from which it was painted. But it was a lovely little scene.

Another instance of fortuitous decoration which I call to mind contained a great number of objects. Here again was a table of shining wood. There was a great bundle of papers at one side and a lot more lying loosely and untidily about. There was a green book with a red back—a dictionary as a matter of fact, and an unposted letter with the usual red stamp upon it.

To match these objects there were several pens and pencils of varying colours in a glass tray, a bradawl, and on a saucer a small glue-pot, with shining glue glistening where it had hardened upon the edges, showing a dull reddish brown beneath. In the foreground was a box of water-colour paints, open and showing the processes of various mixings on the little tin palette.

As a matter of fact these things had been thrust together out of the way whilst some rearrangement of furniture was going on or some domestic occasion, such as dusting or the cleaning of a room. But that is how things happen. The vivid red ink reflected in the dark blue of the ink-pot in the first case, and the many bright colours in juxtaposition to the white papers in the second, by the very mention of them, send a thrill of pleasure through the sensitive mind.

Again, how often in the lowest and darkest streets can be seen some ragged little child, dressed—quite by accident—in delightful colour? An old dark green frock, with a dirty white pinafore over it and a touch of scarlet ribbon in the fair hair. The result is delightful. But pull up the child's socks, lace her boots, give her a clean pinafore, scrub her face and sew up the rents in the green dress and all the beauty is gone; and (like as not) the natural grace of the child, which was part of the general pleasing effect, will be gone also. There is no essential beauty in squalor and dirt, any more than there is in an untidy room. But both unpleasant qualities occasionally contrive to present a pleasing appearance in certain contingencies.

Light Effects

Light plays a great part in producing a discordant or harmonious effect from given groups of objects. What would in bright sunlight appear sordid and ugly might in a subdued atmosphere be transformed into a scene of beauty.

A Lancashire canal, its calm surface broken by a barge which moves slowly along, with chimney-stacks looming in the distance, has great possibilities in a lowering light.

The jagged lines and corners that would at noon stand out with detailed insistence become merged before evening into broad and significant outline. Colours and tints murky and faded, under the exposure of sunlight, assume a rich and sombre blend.

On the other hand, a field of corn with poppies adding touches of vermilion to its bright yellow, is seen to full advantage under a cloudless sky.

It is, of course, glimpses such as these that are detected by the trained observation of the artist and which form the abiding pleasure of his every day. For it may be well said that there is a deal more beauty in the world than ugliness if you have but the eye to see it.

J. G. B. L.

Continued from page 308.

BUSINESS AND COMMERCE:

***Contributors*:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).**

COMMERCIAL TRAINING.—XXXIV

FROM the point of view of the student of business and commerce, it is of the utmost importance that he shall possess a thorough working knowledge of stocks and shares.

Stocks and—

Stock is almost invariably issued in amounts and multiples of £100. It is always fully paid when the certificates are issued; but a part of any holding may be sold and the balance retained, though occasionally a proviso is made limiting the amounts to be sold to multiples of £10. In some cases, as with Inscribed Stock, no certificates are issued to holders of stock; the details of the various holdings being kept in a Stock Book, which the seller is called upon to sign personally, or by his attorney or personal representative, should a transfer take place.

The difference between stock and bonds is considerable. Bonds are often issued as security for money borrowed by governments or municipalities; and are quite as marketable and negotiable as stock. Frequently "Bearer Bonds" are issued; and these instruments, seeing that they are not identified with an individual, may be bought and sold without the formality of transfer deeds and similar documents.

Shares, in contradistinction to stock, embody a holding of any value in the affairs of a limited liability company. Shares are actually numbered at the time of issue consecutively, and a share throughout the life of the company is known by its own distinguishing number. Shares may be of any value.

Shares may not usually be divided for the purposes of sale. Thus, as the possessor of £100 in stock a man may sell one half, for example, or the worth of £50. A man possessed of a share may not dispose of half a share, however. Assuming him to be possessed of one hundred shares numbered consecutively from 201 to 300, he could, however, sell fifty of them, retaining the balance for himself.

This, broadly, is the difference between stocks and shares. The holder of stock has no liability, for his holding has been fully-paid, but the shareholder is liable up to the complete face value of his shares until they have been fully paid. And, in the case of shareholders in joint stock banking companies they are liable up to the value of their unpaid shares, even after they have sold them and so long as they remain unsold a second time.

Shares

Thus, A possesses shares to the face value of £100, £75 paid-up, in a bank. A sells his holding to B and the bank makes a call upon its shareholders for the balance on each £100. B is not able to meet the charge, so A becomes liable for the amount; but if B had sold to C, B would remain liable and the responsibility of A in the matter would have ceased to exist.

Both stock and shares are held by capitalists who have invested their money for the purpose of earning some regular return upon it. The return paid upon the profits of a company, seeing that it may vary from time to time is termed a "dividend." The return upon money invested at a firm rate is known as "interest." Broadly speaking, the terms interest and dividend have become synonymous, but there still remains the clear distinction indicated.

Dividends and interest upon stock and shares held in concerns in this country are almost invariably paid by warrant, dispatched by post as an ordinary cheque, bearing a twopenny revenue stamp and crossed for payment to one's bankers in the usual way. Generally, these disbursements are made twice a year, government dividends being payable in some cases on January 1, and again on July 1. In the

case of some companies where the value of the dividend is a fluctuating item what is termed an " interim " dividend is paid at the close of the first half of each financial year.

Thus, we may imagine a company paying upon its Ordinary shares (a term to be explained later) an annual dividend equal to 15 per cent. upon the capital invested. The financial year of the company begins on March 1. At the end of September, therefore, we may assume that the books are balanced and that a meeting of the Directors is called to discuss the financial position.

Interim Dividend

It is brought forward that the profits of the company compare favourably with the corresponding period of the previous trading year and a decision is made to advance to the shareholders 5 per cent. of the earnings on their invested capital. In the course of a week or two, when the necessary formalities have been completed, dividend warrants for 5 per cent. are therefore dispatched to the various people interested, and this payment is termed an " interim " dividend.

In due course the end of the financial year is reached and the position discussed again, when it is ascertained that the company has done as well as formerly and that it can again disburse profits to its shareholders at the rate of 15 per cent. per annum. A further dividend warrant is then dispatched to each shareholder, drawn at the rate of 10 per cent. on his holding, thus making 15 per cent. on the business year.

From almost all interest and dividends paid upon stocks and shares, excepting from bearer bonds paid by coupon, Income Tax at the prevailing rate is deducted ; so that the warrant received is for the amount due, less Income Tax, the company or corporation paying the tax direct to the revenue authorities at the time the dividend or interest becomes payable. Even if the recipient's income should only be £10 per annum, the tax is still deducted ; but stock and shareholders whose income does not exceed the limit prescribed by law may claim the return of the amounts deducted from interest or dividend warrants by applying to Somerset House or the local Inland Revenue office.

Stocks and shares may be divided broadly into four main classes, Ordinary, Preferred or Preference, Deferred and Debentures. The Ordinary stock or shares of a company hold no particular rights or benefits for their proprietors, and the holders are only entitled to share in the profits of the concern after any other obligations have been met.

Preferred Stock or Shares and Preference Shares as terms are synonymous. A Preference share is usually issued at a fixed rate of interest ; and the holder may never expect to obtain more. In the division of profits the Preference shareholders must be paid before the Ordinary holders are entitled to participate and in the event of a business being wound up the Preference holders possess prior claims in the division of assets.

The great bulk of Preference shares issued, especially those of industrial companies, are known as " Cumulative Preference." The meaning of this term is as follows : If in any one year the profits of the business are insufficient to pay the full percentage upon the Preference stock or shares the deficit must be made up in the succeeding year or years before the Ordinary shareholders may in any way participate.

In some instances Preference shareholders possess but few rights in the matter of voting at shareholders' meetings ; in other cases they may possess rights equal to those of the Ordinary holders.

Deferred Shares and Debentures

Preferred-Ordinary shares are a class issued when there are Founders' shares or a class of Deferred shares before them ; that is to say, a volume of shares to be remunerated after the Preferred-Ordinary shareholders have been satisfied.

Deferred shares are those the holders of which are not entitled to participate in profits until the shares of the Preference and Ordinary class have been dealt with for dividend.

Debenture stock comes under a totally different heading. The Ordinary and Preference shares are instituted for the creation and development of a company ; Debentures are more in the nature of a loan raised to assist the actual capital of the company. To put the matter more plainly, the raising of Debenture stock means the pledging or mortgaging of some part of the assets of the company, for Debentures are usually only issued as a mortgage.

Strictly speaking, Debenture holders are not shareholders of the company. A. B.

CHOOSING A CAREER.—XXXVIII

In the course of this series of lessons we have now completed the broad group callings and professions. We come now to the more independent and self-contained careers ; and it is the purpose of our series to deal with them in alphabetical order.

Accountants.—To become a chartered accountant it is required that the candidate shall pass a preliminary examination as prescribed by the Institute of Chartered Accountants, whose address is Moorgate Place, London, E.C.1. Having been accepted as a candidate, the beginner will then be articled for a term of five years to a chartered accountant.

When the articles have been half served the candidate may take the intermediate examination, and at the close of his training, the final. There are small fees to be paid for each examination; and, on passing his final, the young accountant becomes an Associate (A.C.A.), whilst, after following his profession for five years, he may become a Fellow. There are admission fees to be paid in each grade.

Another institution concerned with this profession is the Society of Accountants and Auditors, of 4, King Street, London, E.C.1. Much the same rules apply; but articles are not insisted upon. For those who are unable to afford to pay a premium there is no reason why they should not enter a chartered accountant's office as a paid clerk or junior and, by devoting a proportion of their leisure to evening classes and study, qualify eventually for membership to the Society of Accountants and Auditors.

Actuaries.—An actuary is invariably the official of an insurance company, his work being to evolve and to prepare all those intricate figures and calculations concerned with every kind of insurance business. An actuary should have an exceptional head for mathematics and for accountancy; and should have specialised in insurance work. Very high salaries are paid to actuaries, many of these officers receiving from £800 to £1,500 a year.

Frequently a junior clerk in the office of an insurance company rises eventually to become an actuary. There is the Institute of Actuaries (Staple Hall, Holborn, London, W.C.1), which provides certain educational facilities for those wishing eventually to take up this calling; and there are examinations for admission to the Institute, of which actuaries may become Associates or Fellows.

Advertising Agents.—The work of the advertising agent is to act in an advisory capacity to advertisers; and to obtain advertisements for the various newspapers, periodicals, magazines, books, hoardings and other media. He derives his remuneration under a system of commission from the proprietors of the different publications and hoardings.

The best way of becoming an advertising agent is to enter the office of an agent in a junior capacity; and, to a limited extent, there is an opening for girls as well as boys. From the office staff the canvassers are drawn, both men and women; who go round not only seeking to book advertisements but also offering to give professional advice.

The Army.—Offering good pay and prospects to young men fond of the open air life and of travel, the Army forms an interesting career. Apart from mere soldiering, there is work for all classes of specialist tradesmen and craftsmen. Full particulars of the latest regulations are obtainable through any recruiting office, the address of which is to be ascertained at a Post Office.

Commissions in the Army for those who have passed through the public schools are obtainable by graduating through Sandhurst or Woolwich.

Asylum Officials consist of stewards, store-keepers, male and female attendants, matrons, nurses, clerks, gardeners and so on. In the case of the county and municipal asylums, vacancies are usually advertised in the columns of the local newspapers, and candidates are invited to write to the official and address given for forms of application. In some cases there is an opening for married couples.

In the case of criminal lunatic asylums application should be made to the secretary of the Prisons Commission, for England and Wales, Whitehall, London, S.W.1; for Scotland at Edinburgh; and for Ireland at Dublin. For posts in the institutions of the Metropolitan Asylums Board application should be made to the offices of the Board, Victoria Embankment, London, E.C.4.

For posts in private lunatic asylums written application should be made to the medical men owning or managing the institutions.

Auctioneers frequently add to their business an agency for fire and life assurance, a house and estate agency, valuation and the work of collecting house rents. There are no definite qualifications for becoming an auctioneer; and anyone paying an annual licence of £10 may style himself an auctioneer; whilst, for that matter, a lady may also do so.

Generally speaking, however, it is far better for an auctioneer to become a member of the Auctioneers' Institute, 34, Russell Square, London, W.C.3. At this Institute a series of examinations is held and certificates are issued to successful candidates.

Aviators may be said to form one of the newest classes of workers, with a great field opening before them. Candidates for the ranks of the aviation profession will first need to serve a period of apprenticeship in the workshops and engineering sheds in order to become personally acquainted with the construction of aircraft, internal combustion engines, and so on; and the fees for such tuition are large.

Intending candidates for aviation should study the various trade journals, in which they will find the names and addresses not only of aeroplane engineers but also of aviation schools.

Bakers, that is, journeymen bakers who perform the practical duties of the craft, earn up to 70s. a week, according to the locality. Journeymen invariably start as boy assistants in the bakery or as delivery boys; in some bakeries the juniors work part time in the bakehouse and part time on the round. In Scotland a system of apprenticeship pertains.

Bank Clerks represent a very considerable proportion of the staffs of our banks, and from the clerks are recruited cashiers, assistant managers, managers and travelling inspectors. To become a clerk in the Bank of England it is necessary to obtain the nomination of one of the directors and to be between 18 and 22 years of age.

So far as the joint stock banks are concerned, each has its own rules and regulations of entry; and the best plan is for the candidate to write for instructions to the secretary at the head offices of the bank. In some cases an entrance examination has to be passed; in others a nomination from a director is asked; and generally there is a more or less rigorous medical test.

Even with banking there is every opportunity for clerks to improve themselves by self-education. The Institute of Bankers, 34, Clement's Lane, London, E.C.1, offers certificates and associateships to those who will pass its examinations.

Basket Making is one of the oldest of crafts and forms a subject of tuition at most of our technical institutes. Basket makers are invariably paid on piece work. There are trade societies, and a system of apprenticeship is in vogue. Candidates should apply to the local basket makers for their terms of apprenticeship. A. C. M.

Re BLACK

STATEMENT OF AFFAIRS

Gross Liabilities £	s.	d.	LIABILITIES *As Stated and Estimated by Debtors*	£	s.	d.	*Expected to rank* £	s.	d.
6,000	–	–	Unsecured creditors				6,000	–	–
2,300	–	–	Creditors fully secured	2,300	–	–			
			Estimated value of securities	2,500	–	–			
			Surplus to contra	200	–	–			
400	–	–	Creditors partly secured	400	–	–			
			Less value of securities	150	–	–	250	–	–
100	–	–	Creditors for taxes, etc., payable in full						
			Deduct contra	100	–	–			
£8,800	–	–					£6,250	–	–

DEFICIENCY

	£	s.	d.
Excess of Assets over Liabilities on Jan. 1, 1912	5,400	–	–
Net profit from business Jan. 1, 1912, to Dec. 31, 1912	3,000	–	–
Deficiency as per Statement of Affairs	1,950	–	–
	£10,350	–	–

BOOK-KEEPING.—XXXII

WHERE a person finds himself unable to meet his creditors, provision is made in the Bankruptcy Laws whereby both the debtor and the creditors are protected against each other. These laws, which were formerly contained in the Bankruptcy Acts of 1883 and 1890, are now consolidated by the Bankruptcy Act of 1914. In order that a person may be made bankrupt, he must :—

(*a*) Be amenable to the bankruptcy jurisdiction.

(*b*) Have committed an act of bankruptcy, and

(*c*) Be indebted to a creditor or creditors, who will act jointly against him in a sum of at least £50.

Bankruptcy

Bankruptcy proceedings are commenced by the presentation of a petition, either by or against a debtor. This is followed by a receiving order in case the Court is satisfied that the above conditions are fulfilled. Where the debtor himself presents a petition, it is necessary that he should submit a statement of his affairs within three days of the making of the receiving order. Where the receiving order is made on a creditor's petition, however, he has seven days allowed for the preparation of his statement of affairs. The statement of affairs, together with a further account known as the Deficiency Account. is prepared by the debtor with or without professional assistance.

Statement of Affairs

The statement of affairs consists of ten sheets, lettered respectively A to J, whilst the Deficiency Account bears the letter K. The front page of the statement of affairs consists of the totals carried from the ten sheets A to J. List A contains particulars of unsecured creditors ; lists B and C particulars of fully and partly secured creditors ; list D the liabilities of the debtor on bills discounted other than his own acceptances ; list E contingent liabilities, such as guarantees, loans by the wife, etc. ; list F creditors for rent recoverable by distress ; G preferential creditors for rates, taxes and wages ; H full particulars of property not included in any other list ; I debts due to the estate ; and J bills of exchange and promissory notes available as assets.

AND WHITE

AT DECEMBER 31, 1914

ASSETS *As Stated and Estimated by Debtors*	£	s.	d.	*Estimated to Produce* £	s.	d.
Property :—						
Cash in hand				200	–	–
Stock-in-Trade				1,900	–	–
				2,100	–	–
Book Debts :—						
Good				2,000	–	–
Doubtful	300	–	–			
Bad	500	–	–			
	£800	–	–			
Estimated to produce				100	–	–
Surplus from securities per contra				200	–	–
				4,400	–	–
Deduct creditors for preferential taxes, etc. (per contra)				100	–	–
				4,300	–	–
Deficiency as per Deficiency Account				1,950	–	–
				£6,250	–	–

ACCOUNT

	£	s.	d.	£	s.	d.
Loss arising from business from Jan. 1, 1913, to Dec. 31, 1914				4,300	–	–
Bad debts				700	–	–
Expenses since Jan. 1, 1912, other than Trade Expenses : viz.						
Black : Household expenses	2,000	–	–			
White : Household	2,850	–	–			
				4,850	–	–
Loss on Valuation of Freeholds				500	–	–
				£10,350	–	–

The deficiency account (list K) is in reality a Capital Account in which the sides are reversed. In the official form the two sections Dr. and Cr. are placed one over the other, what would be the credit side of the Capital Account being placed at the head of the sheet. This concludes with the deficiency, as per statement of affairs, which is the amount necessary to balance the two parts of the account. Should there be a surplus such surplus would appear in the other half of the account. The deficiency account commences with an amount which is known to be the excess of assets over liabilities on a given date. All gains or profits that have accrued since this date are added, and all losses, expenses and the like deducted, the amount remaining being the deficiency as per statement of affairs.

The Balance Sheet of a going concern differs from the statement of affairs, as the latter must give estimated values based on the assumption that a forced sale is about to take place. In order to illustrate the matter the following exercise is presented and worked (see pages 364 and 365) :—

From the following particulars prepare a Statement of Affairs and Deficiency Account as on December 31, 1914, for the information of the Creditors of Black and White, who are insolvent. Cash in hand, £200. Book Debts : Good, £2,000 ; Doubtful, £300 (estimated to produce £100) ; Bad, £500. Stock-in-trade valued at £1,900. Freehold Property cost £3,000, estimated to produce £2,500 ; this property is assigned to creditors for £2,300. Shares held, £150 ; these are given as security for a debt of £400. Creditors : Unsecured on open account, £5,000 ; on Bills Payable, £1,000. Partially secured by shares, £400. Fully secured on Freehold Property, £2,300. Preferential claims for Taxes, Wages and Salaries, £100. Black's drawings, £2,000. White's drawings, £2,850. The business commenced on January 1, 1912. Black put into it £2,500, and White £2,900. The first year showed a profit of £3,000, but the next two years showed a loss of £4,300. No provision was made for Bad Debts.

National Union of Teachers.

Definitions of Terms

An Act of Bankruptcy is one of the acts enumerated in the Bankruptcy Act as being sufficient to satisfy the Court that a debtor is insolvent. These are eight in number :—

(1) Making a conveyance or assignment of property to a trustee for the benefit of creditors generally.

(2) Making a fraudulent conveyance, gift, delivery or transfer of property.

(3) Making a conveyance or transfer of property or creating a charge which would be viewed as a fraudulent preference if the debtor were adjudged bankrupt.

(4) With intent to defeat or delay creditors if the debtor departs or remains out of England, departs from his dwelling-house, or otherwise absents himself or begins to keep house.

(5) Allowing execution to be levied by the sheriff, and the goods sold or retained for 21 days.

(6) Filing a declaration of inability to pay debts, or presenting a bankruptcy petition against himself.

(7) Non-compliance with a bankruptcy notice.

(8) Giving notice to any creditor that the debtor has suspended or is about to suspend payment of debts.

A Bankruptcy Notice is a notice signed by a creditor or by that creditor's solicitor, requiring a judgment debtor to pay the judgment debt in accordance with the terms of the judgment, or to secure or compound for it to the satisfaction of the creditor or the Court. This notice is not an act of Bankruptcy, but failure to comply within seven days constitutes an act of Bankruptcy.

The creditor must take advantage of the act of Bankruptcy within three months of its committal, otherwise a petition cannot be presented until another act has been committed. The bankruptcy is deemed to commence with the first available Act of Bankruptcy within three months of the Receiving Order.

Note.—A debtor is not a bankrupt merely because he is insolvent, nor when a petition is presented, nor on a receiving order being made. It is necessary that he should be adjudicated bankrupt.

Work the following exercise :—

Exercise

From the undermentioned particulars prepare a statement of affairs for Miss Jones, Costumier, who is insolvent.

	£
Cash in hand	25
Book debts—Good	750
Doubtful	250
Bad	375
Estimated to produce	175
Stock in trade which costs £2,500 estimated to produce	1,875
Fixtures which cost £1,250 for materials and labour, estimated to produce ..	250
Freehold property valued at £2,500, subject to a mortgage of £2,000, estimated surplus	500
Miss Jones's private estate is estimated to produce	375
Creditors are :—	
Unsecured	4,500
Secured on mortgage of the real estate as above mentioned	2,000
Preferential creditors, without rates, wages, etc.	400

KEY :—Total Statement of Affairs .. £4,500
Deficiency 1,500

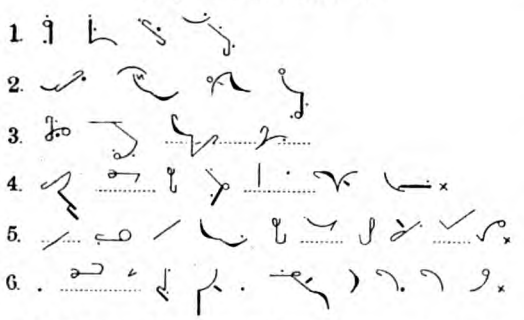
F. H.

SHORTHAND.—XIX

Key to Exercise 67

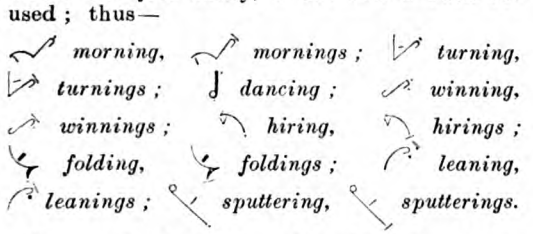
1. instrument, inhospitable, inheritance, inhabitants, relevant, irrelevant, irrelevance.
2. moderate, immoderate, noticed, unnoticed, known, unknown, liberal, illiberal.
3. *over*head, *under*stand, *almost*, *always*, *al*mighty, *number*less, *under*neath, *chair*man, *high*road.
4. continue, complain, inconclusive, interfered, magnetometer, self-praise, self-condemns, self-possession.
5. *You-should-not* interfere *with-the inscription on-the Constitutional* Club.
6. *The selfish* boy *inscribed his* name *on the* door *of the school.*
7. *We-are very*-pleased *with-the instruction given at-the* local Technical College.
8. *The* reports *of-the* Commission *are most instructive in every-way.*

Key to Exercise 68



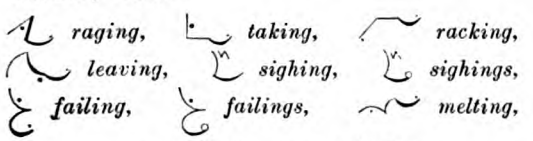
Suffixes and Terminations.—As in the case of the prefixes, most of the suffixes and terminations are represented by facile outlines written according to the general rules of the system. It is necessary, however, in a few cases to adopt contracted forms.

-Ing, -Ings.—Where the forms ⌣ ⌢ would not join easily, a dot and a dash are used; thus—



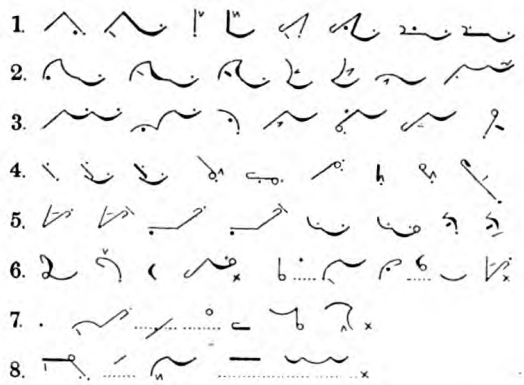
morning, mornings; turning, turnings; dancing; winning, winnings; hiring, hirings; folding, foldings; leaning, leanings; sputtering, sputterings.

In a majority of cases the stroke forms are written; thus—



raging, taking, racking, leaving, sighing, sighings, failing, failings, melting, cutting, cuttings.

Exercise 69



Key to Exercise 69

1. reaping, robbing, tying, dying, watching, waging, waking, wagging.
2. laughing, loving, loathing, saying, showing, mowing, renewing.
3. ringing, mailing, airing, rowing, hang, weighing, hoeing.
4. patting, panting, bending, pouncing, cleansing, rinsing, doubting, spouting, spluttering.
5. churning, churnings, carving, carvings, fitting, fittings, hoarding, hoardings.
6. *There-is-no* flying *without* wings. *It-is a* long lane *that-has no* turning.
7. *The* morning *hour has gold in-its* mouth.
8. Gossiping *and* lying *go hand-in-hand.*

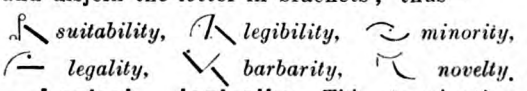
-Ality, -ility, -arity, -ority.—Such terminations as these are expressed by disjoining the stroke immediately preceding the termination. Underline the termination, and put in brackets the disjoined letter, in the following words—

suitability, legibility, minority, legality, barbarity, novelty.

Your effort should give the following result—

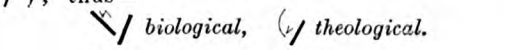
suita(b)ility, legi(b)ility, mi(n)ority,
le(g)ality, bar(b)arity, no(v)elty.

Hence we omit the termination underlined, and disjoin the letter in brackets; thus—



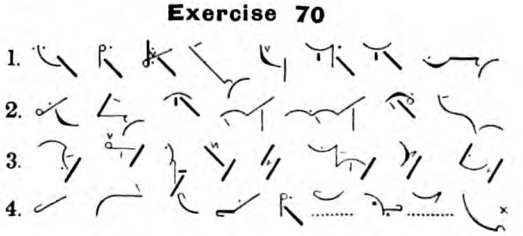
suitability, legibility, minority, legality, barbarity, novelty.

-Logical, -logically.—This termination is always represented by disjoining the stroke / *j*; thus—



biological, theological.

Exercise 70



Key to Exercise 70

1. affability, stability, desirability, popularity, vitality, notability, nobility, angularity.
2. servility, jocularity, mobility, mortality, immortality, impossibility, formality.
3. mythological, psychological, astrological, biological, geological, entomological, zoological, genealogical.
4. *We* look *for greater* stability *in-our* aircraft *in-the* future.

-Ment.—This ending is generally expressed by *mnt*, as in *detriment*, *discernment*. Where this sign does not join easily, the contracted form may be written; thus—

announcement, *pavement*, *merriment*.

-Mental, -mentally, -mentality.—A disjoined *mnt* represents these terminations; thus—

sentimental-ly-ity, *experimental*.

-Ly.—This is expressed by *l*, joined or disjoined, as in—

costly, *instantly*; or by hook *l*, as in *roughly*, *sensitively*, *possibly*.

-Ship.—A joined or a disjoined *sh* represents *ship*; thus—

chairmanship, *stewardship*.

-Fulness, -lessness, -lousness.—The termination *-fulness* is expressed by a disjoined *fs*, as in *gracefulness*; the terminations *-lessness* and *-lousness* are represented by a disjoined *ls*; thus—

heedlessness, *incredulousness*.

Logograms as Suffixes.—Joined or disjoined logograms may be used as suffixes; thus—

welcome, *indifference*, *misgivings*.

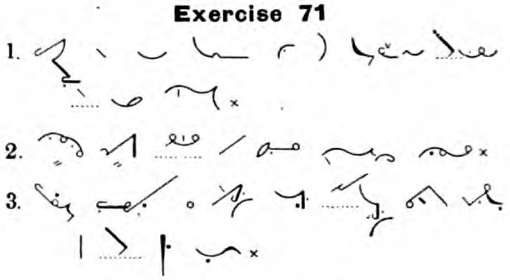
It should be noted that a contracted logogram takes dot *ing* and dash *ings*.

Compounds of here, there, where.—The words *at, to, of, with, in, on*, are added to the words *here, there, where* as follows—

at by the stroke *t*; *to* by its logogram; *with* by *TH*; *in* by its logogram; *on* by hook *n*; thus—

hereat, *thereto*, *herewith*, *therein*, *whereof*, *hereon*.

Exercise 71



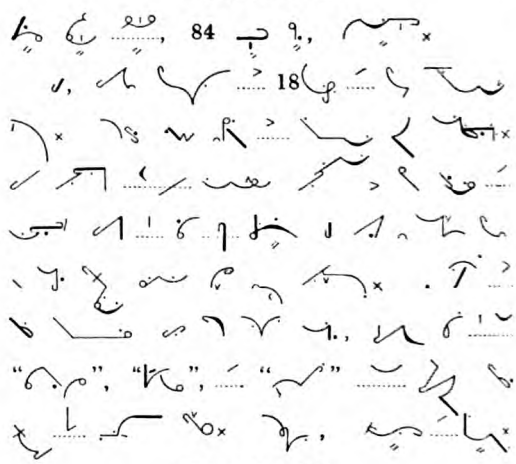
Key to Exercise 71

1. *We-shall-be*-glad *to know if-you-can* let *us have-the* consignment *by-the* commencement *of next* month.
2. Messrs. Ward & Sons *are first*-class monumental masons.
3. Please-note-*that-the* glassware *is* urgently needed *and-we* confidently hope *to*-receive *it by-the* date named.

Prefixes and Suffixes and Terminations.—The following points are worthy of attention as comparing and contrasting the prefixes and suffixes—

1. An initial dot represents *com* or *con*; a final dot represents *ing*.
2. An initial represents *enter, inter*, or *intro*; a final represents *ment*.
3. An initial disjoined represents *magna-e-i*; a final disjoined represents *logical-ly*.
4. Logograms may be used either as prefixes or suffixes.

Exercise 72



Exercise 73

1. *The* play "Sentimental Tommy" *was one of-the* novelties *of-the*-season.
2. *We*-beg *to*-request *you to* remove-*the* scaffolding *within-the next* week.
3. *Our* Entomological Society *was* entertained *by-the* Zoological Society.
4. *The* men showed sedulousness *in-the* transhipment *of-the* cargo.

From the wall painting by Frank Brangwyn, A.R.A. in the Royal Exchange.

MODERN COMMERCE.

SPECIAL SUBJECTS

No. 5.—THE STORY OF TRADE UNIONISM

FROM the point of view of the student, whether woman or man, a knowledge of the power and development of trade unionism is of the utmost importance. It is mingled indissolubly with modern social and industrial conditions; it crops up in every phase of business and commerce; it affects our daily lives in a hundred ways.

Trade Unions are associations of industrial wage-earners with a view to the safeguarding of their collective interests and the betterment of their conditions of employment.

Trade Union and Guild

Unfortunately, an idea has spread abroad that a trade union exists largely for the purpose of fostering and managing the strikes of disgruntled workers. Nothing could be further from the truth. The connection between trade unions and strikes has been somewhat unduly emphasised by the fact that, except in time of industrial warfare, one reads very little in the newspapers about these associations and about their normal routine.

The Trade Union in reality is a highly-organised institution, with large reserves of money invested in property or gilt-edged securities; it has valuable premises; it is staffed by highly-technical workers; in many cases it sends a representative to the House of Commons. Every day trade experts meet at its offices for the discussion of difficulties and disputes and the settling of minor troubles betwixt wage-earner and employer. Little matters these, they do not find any space in the newspapers; yet, actually, they stamp out the first embryonic flutter of countless strikes and lock-outs.

1825 is the date of the inception of the Trade Union, in its modern sense, in this country; though, of course, trade associations existed long before then—right back in the Middle Ages. The Trade Union, however, although no doubt the lineal descendant of the Guild is wholly distinct from it. The function of the Guild was to protect a trade; the function of a Trade Union is to protect the workers in a trade.

Trade Societies, the immediate precursors of the modern unions, were more in the nature of friendly or provident institutions. They received contributions from their members and, in return, disbursed sickness and out-of-work pay or funeral allowances. At their meetings, no doubt, trade grievances were freely discussed; but not from the same standpoint as now, for the relationship between Capital and Labour was totally different. The apprentice of to-day became the journeyman of to-morrow; and the journeyman of to-day developed in many cases into a master man himself.

Broadly speaking, it was the coming of machinery that started trade unionism proper. The man whose money bought the first engine was the prototype of Capital as we know it to-day.

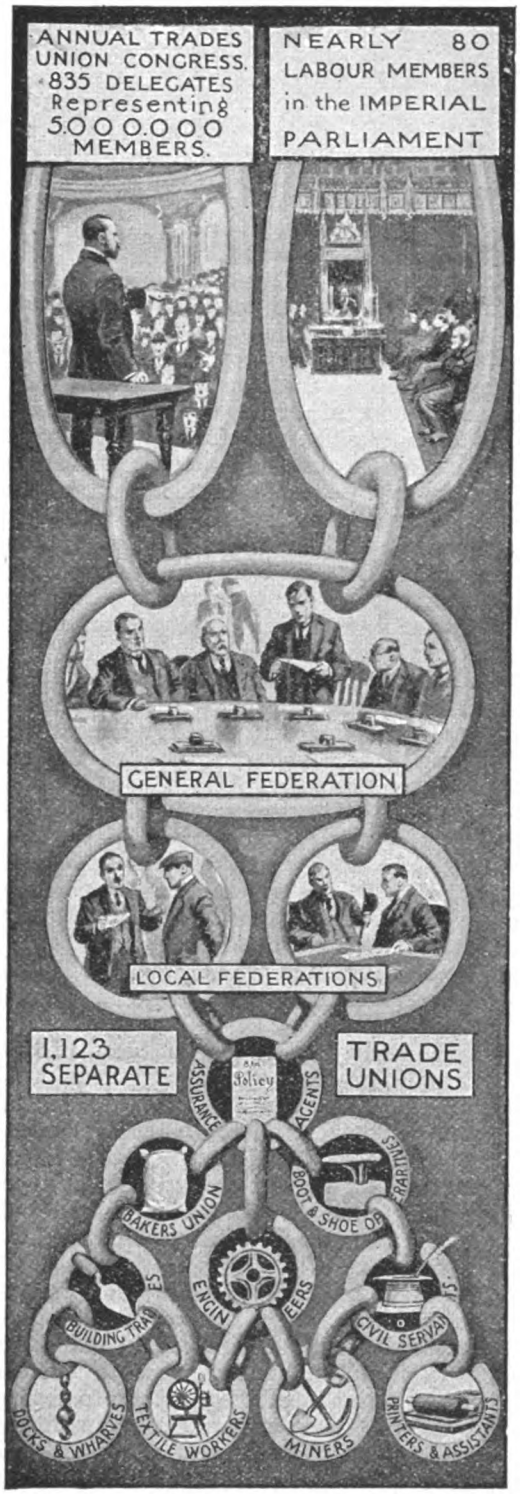
Legal Recognition

But the development of the movement was beset by many thorns. For many years associations formed for the restraint of trade were considered illegal; not until 1871 was the Trade Union Act passed and legal recognition and status given to the movement.

In the early days men who joined unions took oaths of secrecy and allegiance. Always liable to be haled before the justices for conspiracy, they had to meet clandestinely. Indeed, so recently as 1834 six agricultural labourers were arrested, charged with the crime of joining a union, and sentenced to transportation to Botany Bay for seven years!

To-day some eighty Members of Parliament are the direct representatives of organised Labour. There are in existence more than eleven hundred separate unions whose collective membership totals to nearly five millions of men and women representing every imaginary trade and many of the professions.

Many of these unions exercise the functions of a friendly society. The National Health Insurance Act in 1912 gave a great fillip to trade unionism. Under this Act



LINKS IN THE CHAIN OF LABOUR ORGANISATION
which has been forged since 1850, until when labour organisations were almost wholly local in character.

wage-earners had compulsorily to be insured either by the State or approved societies. The outcome of this law was that workpeople flocked to the trade unions as the most convenient organisations for the conducting of their insurance business. The result was that, whereas in 1910 there were 1,195 unions with a membership of 2,446,342, in 1913 there were 1,135 unions with a membership of 3,987,115. The slight reduction in the number of unions is accounted for by the tendency of the smaller unions to amalgamate.

Down to the year 1850, practically speaking, the organisation of labour was purely local in character. This made for weakness and centralisation soon set in. The object of this centralisation was to group together several local unions of one trade in a common centre, and so to add to the strength and driving force of the organisation.

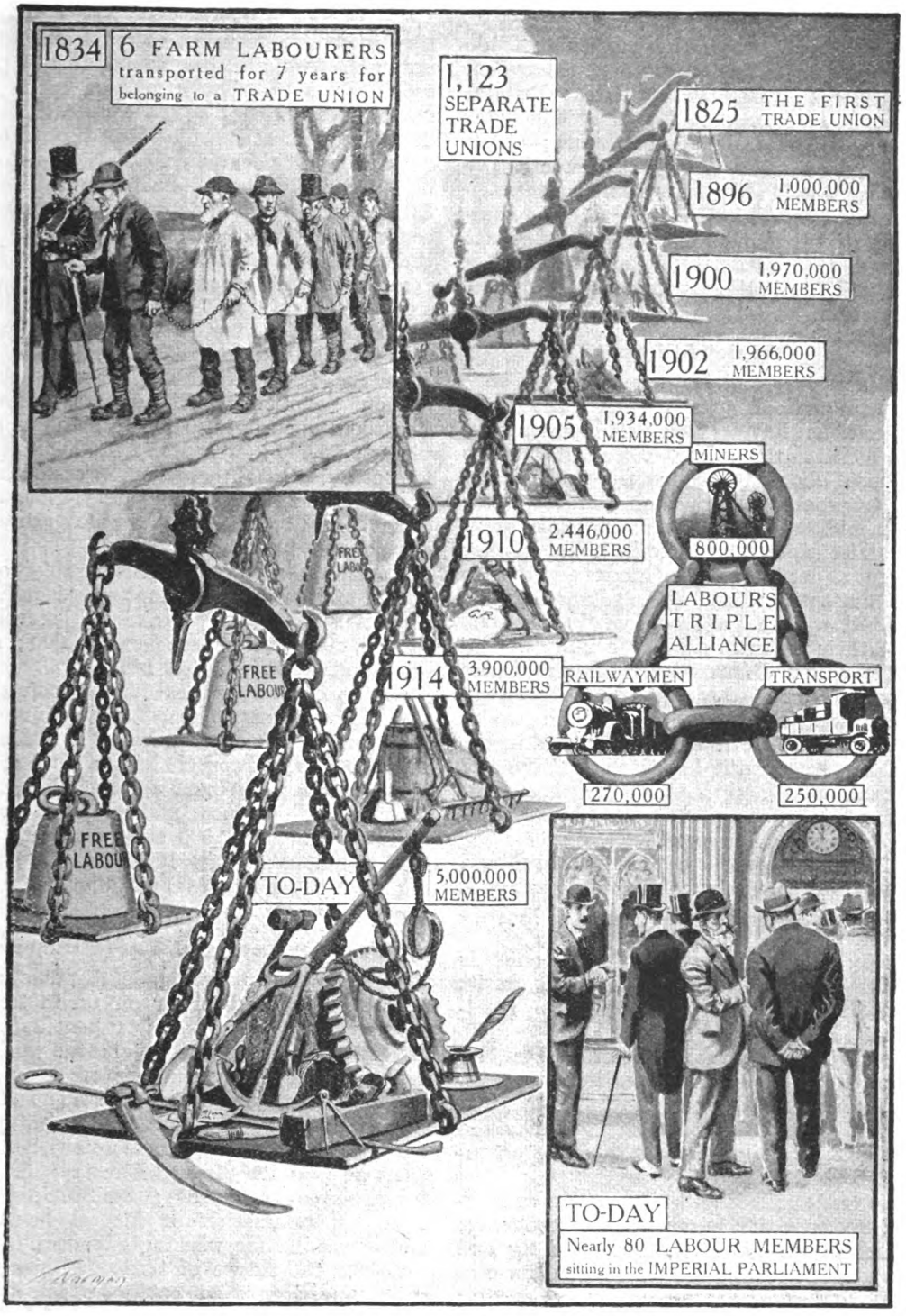
Syndicalism

The centralised unions after a time linked themselves with similar centralised unions in other parts. This brought about a federation of unions. And, from the federations, we have the Trades Union Congress, a vast meeting held annually, the Mecca of British Labour.

Syndicalism is the idea of a Government formed by the Federations of Trades Unions. Thought by many to be anarchistic, it cannot be put forward as the Utopia of Labour generally, and its adherents are certainly to be found among the minority.

British Labour in its organisation has always been strictly constitutional. Its methods have been taken as the model of trade unionism in our overseas dependencies and in foreign countries. It has ever been law-abiding and, beyond the Syndicalists, ready to recognise the voice of Parliament. In some continental countries, however, this cannot be said to be the case. In France and Italy, for example, the united trade unions are frankly opposed to the governments and constitute a social danger for which, happily, there is no counterpart in Great Britain.

Naturally, with some of the trades, there are international federations. Other federations exist solely for the purpose of the common discussion of grievances or trade points. Some possess the power to make levies on the members of the unions to meet the expense of some collective movement. Others, again, possess no financial standing and have no expense, other than the trifling outlay for administrative needs.



THE GROWTH OF TRADE UNIONISM

between 1834 (when six agricultural labourers were found guilty of the crime of joining a union and transported to Botany Bay) and 1920 (when some 80 seats in the House of Commons were occupied by Labour members) is strikingly demonstrated by the above chart.

Much depends upon the particular trade concerned as to the status of a federation. The Miners' Federation of Great Britain, for example, is organised so that it includes all the workers in or about a mine ; and a contribution of a penny per month per member is paid for management expenses.

The Triple Alliance of Industry is composed of the Miners' Federation of Great Britain, the National Union of Railwaymen and the National Transport Workers' Federation.

Triple Alliance

It is a vast and important body ; and, in their outlook upon Capital, the three Federations have much in common. In membership, the miners contribute to the Alliance about 800,000 ; the railwaymen and transport workers more than a quarter of a million each. Moreover, these great Federations are pledged to help one another in time of need ; and it is interesting to note that during a colliers' strike some years ago the railwaymen paid out nearly £100,000 from their funds to assist the miners.

The contributions payable by members to union funds vary very considerably in different trades. In the unskilled trades the payments are usually lower than in the skilled. Among the benefits are strike and lock-out payments ; money for legal defence ; sick, accident, superannuation, funeral, emigration and similar grants.

The majority of trade unions are in a particularly sound financial condition. Funds exceeding £100,000 per union are quite common.

The measure of power of a trade union is naturally dependent upon the funds at its disposal and the moneys of its allied organisations.

It is not desirable therefore for any union to hurry its members into a strike, because a strike entails the issue of strike pay, the dissipation of collective funds and the general weakening of the entire organisation.

No trade union wants either strike or lock-out, however rich it may be. The average union goes about its business quietly and normally year after year. Outside its own particular circle it may hardly be known ; but, all the while, it will act as an efficient friendly society (registered at the Board of Trade for that purpose) ; it will rule its members firmly but with discretion ; it will improve the lot of the worker by a hundred consultations between representatives of both master and man ; it will take a practical interest in politics, national and international. And, in the whole of the proceedings, there will be nothing more abnormal than takes place in the board room of that organisation of capital, the average limited liability company.

The building trades have now a Trade Union membership of a quarter of a million ; coal-mining about 800,000 members. In the metal trades there are more than half a million members, made up of : Iron and steel manufacture, 72,000 : ironfounding, 48,000 ; engineering, 270,000 ; shipbuilding, 102,000 and miscellaneous, 39,000.

In the textile trades there are half a million members made up as follows : Cardroom operatives, 64,000 ; spinners and piecers, 55,000 ; weavers, 221,000 ; others in cotton, 21,000 ; woollen, worsted and stuff workers, linen and jute hands, and other textiles, 84,000 ; textile printing, dyeing and packing, 61,000.

Transport represents considerably over half a million and is composed of railway servants, 337,000 ; tramway servants, carters, etc., 97,000 ; seamen, 129,000 ; and dock and canal workers, 143,000.

In the clothing trades 55,000 boot, shoe and clog workers belong to trade unions ; and also 47,000 other workers in different branches. Woodworkers have a total membership exceeding 60,000 and include among their ranks cabinet makers and coach builders. Over 100,000 shop assistants belong to unions ; nearly 100,000 in the printing and paper trades and about 400,000 general labourers.

Unemployment and Trade Disputes

Unemployment and trade disputes constitute the largest claim on union funds. The ordinary friendly society benefits vary but little from year to year, and the working expenses of the organisations are kept surprisingly low. To make this point clear, it may be mentioned that in a recent year out of every £1 spent by trade unions, 2s. 2d. went to pay for dispute benefits ; 5s. 5d. for unemployed benefits ; 8s. 3d. for sickness, superannuation or funeral benefits ; and about 4s. for working expenses.

As for the future of trade unionism, no more uncertain field could be found for prognostication. With the cause of Labour more and more represented in the Imperial Parliament, however, and with an international comradeship developing among the trade unions, the power of organised labour —be it for good or evil—has certainly not yet reached its maximum development.

Continued from page 300.

ENGLISH LANGUAGE AND LITERATURE:

Contributors:—ENGLISH LANGUAGE (W. A. Craigie, M.A., LL.D.; E. W. Edmunds, M.A.). ENGLISH LITERATURE (John Derry, J.P.). PHILOSOPHY (E. H. Tripp, Ph.D.). POLITICAL ECONOMY (J. W. Urwin). ETHICS (W. H. Koebel). PUBLIC SPEAKING (J. W. Urwin).

POLITICAL ECONOMY.—I

Nine legislators out of ten and ninety-nine out of a hundred when discussing this or that measure, think only of the immediate results to be achieved—do not think at all of the indirect results.

HERBERT SPENCER.
Principles of Ethics.

WHAT Herbert Spencer has said of the politicians may with truth be applied to a great many of our social reformers and philanthropists. A careful study of the principles of Political Economy will, however, give the student broader views and wider ideas of the complex system under which we live.

Political Economy is the chart by which we should steer clear of the rocks and shoals of hastily formed opinions, and should be studied by all who take an interest in and care for the welfare of their fellow men.

Science or Art?

The student will meet all the difficulties which invariably present themselves in elementary chapters dealing with any scientific subject, but these need not discourage him. It will be found that men of eminence differ in their opinions.

This course does not profess to deal exhaustively with a subject which occupies volumes from the pens of learned professors, but it attempts to present the subject in as simple a form as possible and free from bias on matters which are essentially of a controversial nature.

Political Economy has been variously defined, but the most universal or generally accepted definition is "The Science which treats of the general causes affecting the production and consumption of things having an exchangeable value in reference to the effects of such production, distribution and consumption upon the national wealth and welfare."

Social history proves that, with few exceptions, such as a revolution or a war, social and economic institutions are not created by sudden effort but grow on defined lines. Most sciences, if not all, have begun in Arts, that is knowledge was systematised for practical purposes before it was cultivated for its own sake.

The word *economy* is derived from two Greek words meaning "a house or family" and "law," and was used to mean the management of a household or the art of managing the means and resources on which the household depends for its subsistence.

Early Economists

The Greek word is thus used by Aristotle. Political Economy came to mean the same kind of art applied to the means and resources of a nation, to show the methods by which a government can best promote and increase the aggregate wealth of the nation in the interests of the whole of the community.

Inquiries on these matters must have existed from the earliest times in every nation, but Political Economy as a Science is very modern. Crude views on the subject arose in the middle ages in the free Italian Cities and the Hanseatic towns.

So far back as 1595 Sir Walter Raleigh, in 1667 Sir William Petty, and in 1691 Sir Dudley North, wrote on the subject.

In 1768 Francois Quesnay founded a School or Society of Economists in France known as "The Physiocrats" which held the view that the soil is the source of all

wealth, and that commerce only transfers wealth, that the exertions of manufacturers, merchants, and professional men though useful are sterile.

Adam Smith, a Professor at Glasgow University (1751–1764), made Political Economy the subject of a series of lectures; and, subsequently, while visiting Paris he made the acquaintance of Quesnay and other economists of his school of thought. Shortly afterwards he commenced to write his great work the *Wealth of Nations* which, however, was not published until the year 1776.

Buckle described the *Wealth of Nations* as "the most valuable contribution ever made by a single individual to determine the true principles of government." McCulloch, a great authority on economics, said that the work "had exercised a power and beneficent influence on public opinion and legislation of the civilised world which has never been attained by any other work."

The Mercantile System

In company with all other writers Adam Smith, however, had his hostile critics, the most outspoken of these being John Ruskin, who alludes to him as "the half-bred and half-witted Scotchman who taught the deliberate blasphemy thou shalt hate the Lord thy God, damn his laws and covet his neighbour's goods."

Whatever difference of opinion there may have been respecting the conclusions drawn from the *Wealth of Nations* there can be no doubt that its publication stimulated interest in a subject very much neglected up to that time, but of vital importance to the good government and the prosperity of the nation. For this reason, if for no other, posterity is indebted to him.

Though every student of economics should have some acquaintance with the *Wealth of Nations*, he should bear in mind that the work was written more than 140 years ago, and at a time when great changes were taking place, and that vast progress has been made since then.

Smith wrote on the eve of an industrial revolution, and however valuable his work may have been at the time, it has now been superseded in many respects by the writings of more modern authors, although some of his definitions will live for all time.

Among the writers who are regarded as the best authorities may be mentioned John Stuart Mill, J. R. McCulloch, Henry Fawcett, Mrs. Fawcett, Professors Sidgwick, J. S. Nicholson, S. J. Chapman, Edwin Cannan and J. E. Syms. Innumerable writers on Social Reform have also dealt with different branches of the subject from time to time.

The *Wealth of Nations* was primarily an attack on the policy pursued up to that time by most European Governments known as the Mercantile System of managing and controlling the wealth of nations.

We shall deal with the Mercantile System more fully when we come to the question of Imports, Exports and Duties, but it is as well to have, at this juncture, some preliminary notion of the subject, as it forms one of the early links in the great chain which we have to examine.

By the Mercantile System we mean the economic policy which prevailed in Europe from the break up of the mediæval organisations of industry and commerce to the dominance of the system of *laissez-faire* (Palgrave's *Dictionary of Economics*, Vol. 2, p. 727).

The Mercantile System was the result of an erroneous conception of wealth, identifying wealth as money instead of regarding money as simply a measure of wealth. It is an error which, as Fawcett says, when once exposed, "may appear to be incapable of misleading a child. Yet no error was ever more tenaciously clung to; it not only corrupted speculative science but it infected the whole commercial policy of every European nation."

What is Wealth?

Even to-day the term wealth is used in a misleading way. We speak of a man's wealth as so many pounds. We do not mean that he has so many sovereigns or treasury notes but that what he possesses is measured by the money term. The actual wealth may be represented by land, buildings, machinery, or even by securities in public companies, and all he has to show for this is a scrap of paper.

Adam Smith was the first to expose this fallacy and to point out that wealth was "any commodity with an exchangeable value."

Under the Mercantile System the nation's wealth was assumed to be the actual gold or silver it possessed. Commerce was so arranged that the exports of a country should always exceed the imports, and policy was directed towards maintaining the balance of trade in favour of the exporting nation. Home industry was subsidised with this object, the idea being that the

balance was imported in gold or silver, thus assuring an increase in the national wealth.

Gide, a French economist, in his book on Political Economy published in 1914, commenting on the Mercantile System as a method of increasing the nation's wealth, says: "They thought to find a way by selling manufactured goods to foreign countries, and to this end they tried hard to develop foreign trade and home manufacturing by a complicated and artificial system of regulations." Gide, however, does not altogether agree with the theory that Mercantilists were entirely influenced by the desire to obtain more money, but that they had a desire to foster national industry, and the same opinion is expressed by equally competent British economists.

Pure Mercantilism began to wane, and by the end of the seventeenth century the decay was very marked.

Political Economy as a science is purely theoretical. It does not tell us how to get wealth nor does it decide what are the best systems of production, distribution and exchange. It does not decide between the systems of large estates and peasant proprietors, between private ownership of the means of production, distribution and exchange, and collective ownership or State ownership known as Socialism or between the respective advantages of gold, silver and paper as the medium of currency nor the special processes by which different kinds of goods are produced. It deals only with the general conditions peculiar to a nation and the principles which affect the production, distribution and exchange of wealth.

Working for Social Reform

It is well to bear this in mind, because the vagueness of popular conception has created a vast amount of prejudice against Political Economy. It has been described as a heartless and selfish science, and those engaged in the study of it as callous beings whose sole concern is to increase the wealth of the nation, but who are devoid of sympathy and the higher qualities which ennoble the character of man.

In point of fact the political economist is far from being the unnatural creature portrayed; he is seeking to possess that information which will guide him in his endeavour to improve the lot of his fellow man.

No one should undertake or advocate measures of Social Reform without a clear knowledge of the principles of Political Economy, because with the very best intentions may result the very opposite from what they intended.

We have seen this exemplified on many occasions. The Factory Acts were strongly opposed not only by the employers but by the employed on the ground that it was an unnecessary interference with the liberty of the subject, but the underlying principle was to secure the healthiest conditions for the workers and more especially the young children who were employed.

The introduction of machinery has been condemned on the ground that machinery displaces labour. Such may be the case; but while it temporarily displaces labour, it at the same time creates labour and cheapens commodities and everybody benefits.

The Burden of Taxation

Political Economy enters very largely into the methods of taxation and the equitable distribution of this necessary burden on the nation.

All these matters will be dealt with in their turn as well as the systems of Land Tenure, Private Ownership and Socialism, Trade Unions' Strikes and Lock-outs, Co-partnership and Profit Sharing.

Political Economy endeavours to explain not only the conditions which determine progress in national wealth but also the causes which tend to make the material state of a country either stationary or retrogressive.

In the early days it was impossible to obtain information on the rise and progress of the working classes, but now we have Government returns which enable us to compare the rise in wages and the conditions of employment not only at various periods in this country, but also to compare these factors with those of other nations.

The highest principle is the freedom of mankind on just and equitable lines. Fell in his book *The Foundations of Liberty*, says:

"Before discussing politics, that is, before attempting to apply principles to the solution of political issues, let us be sure we have principles to apply and, if we have any, of ascertaining exactly what they are, and on what authority they rest.

"When we have decided what we mean by a man and consequently by a citizen, a government, a state, a nation, then will it be quite soon enough to discuss and pronounce upon the vast political questions which centre round the family, the nation, private property and personal freedom."

J. W. U.

PHILOSOPHY.—X

THE desire to arrive at a monistic or unified conception of reality has always been considered the *summum bonum* of philosophical endeavour. Materialism and spiritualism both start by admitting the existence of a two-fold reality, and in so far they are dualistic, but they seek to become monistic by affirming that the duality is only apparent, matter or spirit, as the case may be, being the one and only underlying reality.

Psycho-physical parallelism is essentially dualistic in nature, the material and the psychical are as the poles asunder, but here again an attempt is often made to merge the " many " into the " one " by adopting the Spinozistic idea of an underlying, all-embracing substance, of which the material and the spiritual are merely the modes of its appearance.

Energetics

One of the latest comers into the philosophical arena is the system of " Energetics," which lays claim to an absolute monism inasmuch as it subsumes both matter and spirit under the concept energy. The merit of having attempted to apply the physical principle of energy to the whole world of phenomena belongs to W. Ostwald, a brief account of whose system will now be given.

In the first place, our knowledge of phenomena in general is conditioned primarily by the activity of our sense-organs, and these function only when work is performed upon them ; every affection of the senses is co-existent with a transfer or transformation of energy. " When we would attract the attention of our fellow men we have to do work, as in speaking, singing, ringing a bell, etc., and when we communicate with them we have to expend more energy in talking, writing, etc.

" Similarly, communication between ourselves and the outer world is only established and maintained by means of energy. When we hear a sound, the air-vibrations do work in the ear drum. When we see, radiant energy performs work on the retina of the eye. When we feel a solid subject, we experience the mechanical work which our fingers perform or which is performed upon them."

Energy alone informs us of the disposition and properties of external things, and the whole of nature is manifested as a distribution of energies in time and space.

What then, we may well ask, becomes of the gross matter of common-sense, the vehicle of energy of nineteenth century science ? The answer is, " Matter is a portion of space in which a number of energies co-exist." Among the properties of so-called matter which appear to be most fundamental are those of mass, weight and persistence (indestructibility).

That all known bodies should have mass appears to be obvious from the consideration that if ever a body existed with no mass, it would fly off from us on the first receipt of energy and disappear into space, i.e., such a body would never come under our observation. Similarly with weight. Experience teaches us that the weights of all bodies are proportional to their masses, and a (conceivable) body with no mass would have no weight ; but as bodies without mass would long ago have left this planet, therefore all known bodies possess weight.

The concept of causation can also be subsumed under that of energy. Two events, A and B, stand to one another in the relation of cause and effect when we can sum up their relation in the form : if A is, then B is, i.e., B does not occur if A has not preceded it. Now the sequence A B is always attended by the transference or transformation of energy. If energy A had not existed, energy B would not have resulted. This is the meaning of causation from the energetic standpoint.

Phenomena of Consciousness

The manifold phenomena of living organisms can be as readily grouped under the concept energy as those of non-living matter. The outstanding characteristic of living things is their " stationary " nature, in virtue of which the changes which proceed in them, and the changes which they condition in the world around them, conduce—in the main—towards the preservation of the individual and of the species. This " stationary " nature is only (conceivably) possible when the energy expended in and by the organism can be readily replenished from another source of energy which can be stored within it in a readily available form.

This form is chemical energy, the two main characteristics of which are that it can be highly concentrated and that it can be preserved for a long time.

In order to bring the phenomena of consciousness under the scope of the laws of energy, it is necessary to postulate the existence of a nervous or neural energy. When a living organism receives a stimulus from the outer world, i.e., a sense-impression free energy enters his system and under-

goes conversion into another form (or forms) which is distributed by the nerves to other parts of the body. This distributed nerve energy may then condition the performance of external work by the organism, i.e., the performance of *actions*, under which word is included not only mechanical acts but the production of all forms of energy which emanate from the organism ; or it may give rise to changes which are inseparably connected with consciousness, such changes being functions of the brain. The immediate conscious effects thereby produced are called *sensations*, and the more remote effects, which are capable of almost indefinite repetition and expansion, are known as *thoughts* Thus action, sensation and thought are all dependent upon the neural energy.

A very important law concerning sensations—Johannes Müller's law of specific nerve-energies—states that the character of a sensation depends upon the character of the excited nerve, not upon that of the external stimulus. Thus the sensation of light is a consequence of the excitation of the optic nerve and is independent of the manner in which that nerve be excited, whether by light itself, or by chemical, mechanical, electrical or other means.

Pleasure and Pain

Sensations may be roughly divided into those which give us pleasure and those which are painful. Pleasurable feelings owe their character to the fact that they facilitate the flow of energies within us ; painful feelings, on the other hand, inhibit or hinder that flow. The stationary nature of a living being, and its power of regeneration, are entirely dependent upon the active and harmonious transformations of energy within it, so that feelings of pleasure and pain are normally safe guides as to its health. Playing, singing, dancing and games are all pleasant pastimes, particularly to the young, because they promote the flow of energies ; it is the expenditure, not the possession, of superabundant energy which gives pleasure, and, usually, the greater the expenditure the greater the pleasure. Excess involves too great an expenditure and a consequent disturbance of the harmonious interchange of energies, but the painful after-effects disappear more quickly in the young owing to their superior power of recuperation.

We have seen that the incidence of external energy, e.g., light, causes the production of another energy called neural energy. Now this transformation is not to be regarded as a simple case of energy transformation ; rather is the external energy to be regarded as a stimulatory or excitatory energy—like the electric current which launches a battleship—which sets free large quantities of energy stored up in the nerve-cells as chemical energy. The neural energy produced then passes either directly to the brain or to the bodily organs where it is converted into work. In the former case, consciousness is evoked ; in the latter case, an unconscious or reflex action is produced.

Investigation of the working of the human mind is more complex than any other, and its results are accordingly less certain, for the reason that it is the human mind itself which investigates ; but if the essence of mind be energy, it is at least intelligible that the whole of nature should appear to us under that form, and that the concept energy should be the most comprehensive of all concepts. But the method of energetics does not start from the concept and, after the manner of the schoolmen, attempt to deduce experience from it ; on the contrary, it takes experience as its base and uses it to control thought.

The apparently insoluble difficulty, experienced by Tyndall and others, of comprehending the transition from the material changes in the brain and nervous system to the corresponding phenomena of consciousness arose from the attempt to refer all phenomena to those of matter in motion. The energetic view regards energy in its manifold forms as the ultimate reality, takes both consciousness and moving matter under its all-embracing wing, and so says farewell to this time-honoured difficulty.

Summary

"Energetics" is a monistic view of reality as it subsumes the totality of phenomena under the concept energy. According to this system :—

Our knowledge of the outer world is conveyed to us by forms of energy.

The so-called properties of matter, e.g. inertia, mass and persistence, are capable of "energetic" interpretation.

The "stationary" nature of living organisms is readily intelligible from the "energetic" standpoint.

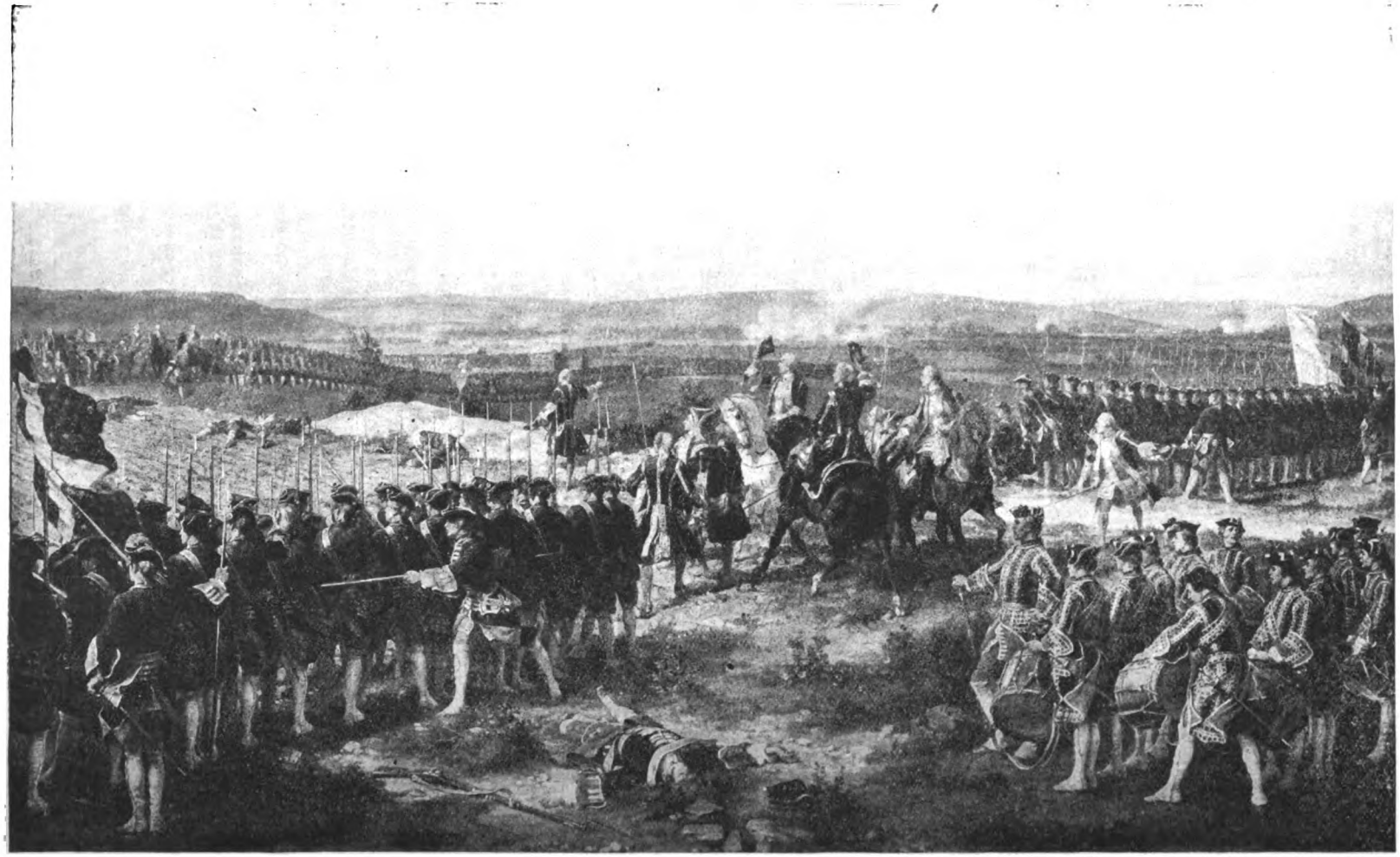
The peripheral nerve-ends convert physical energies into neural energy.

Neural energy conditions actions, sensations and thoughts.

Consciousness is a property of the neural energy which flows through the brain.

Hence there is no real antithesis of matter and spirit.

E. H. T.



From the painting by Philippoteaux in the Victoria and Albert Museum.

THE BATTLE OF FONTENOY, MAY 11, 1745,

was the last of the series of great victories achieved by French arms during the period of military aggression which Louis XIV. inaugurated.

Continued from page 320.

HISTORY:

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THE DECLINE OF THE FRENCH MONARCHY.

THE death of Louis XIV. (1715) left France outwardly great but internally exhausted.

Despite the misfortunes of his later years Louis had retained the earlier of his European conquests and the most valuable of his colonies. The campaigns of Villars and Vendôme had restored the prestige of the French arms, and the treaties of Utrecht, Rastadt and Baden had enabled France to come out of the European war with honour, though not without loss.

A Bourbon King sat upon the throne of Spain. The supremacy of French taste and French literature was acknowledged throughout Europe.

King Louis XV.

But behind this imposing front, the forces which were to result in the downfall of the monarchy were already at work. Incessant wars and the lavish expenditure of the court resulted in crushing taxation, an immense public debt and yearly deficits. The revocation of the Edict of Nantes and the emigration of the Huguenots had struck a heavy blow at French industry. Political power was concentrated in the hands of the King and his ministers.

The nobles moreover, though they retained their privileges, were deprived of political influence and employment; whilst the voice of the middle class, increasing in wealth and intelligence, could already be heard—the middle class, and the peasants, ground down by taxation and subject to vexatious services.

The reign of the *Grand Monarque* had made France glorious in arms, in arts and in letters, but it had neither established a stable political system nor had it brought prosperity to the mass of the people.

These were the circumstances under which Louis XV., then a child of five years old, ascended his great-grandfather's throne. The old King had provided in his will for a council of regency, of which his nephew the Duke of Orleans was to be president. On his death, however, the Duke succeeded in obtaining practically uncontrolled power, his chief adviser being the Abbé (subsequently Cardinal) Dubois.

Orleans was a man of amiable disposition, and considerable parts; Dubois possessed energy and great ability, especially for foreign affairs; but both were cynical, unscrupulous and immoral. The licentiousness of the court, repressed by the austerity of the late King's closing years, burst forth with renewed licence. The profligacy and extravagance of French society under the Regency exceeded anything hitherto seen in modern Europe.

Financial Confusion

The foreign policy of the Duke of Orleans was dictated by distrust of Philip V. of Spain, who was determined, in defiance of the Treaty of Utrecht, to assert his claim to the French succession. When Philip attempted to regain the lost Italian provinces of Spain and reduced Sardinia, Orleans at once entered into negotiations with England. In January, 1717, a triple alliance was formed between France, England and Holland, by which the exclusion of Philip from the French throne was guaranteed.

In 1718, when Spain invaded Sicily, a Spanish Fleet was destroyed by Sir John Byng; Austria and Savoy then joined the Alliance. A French Army under Berwick entered Spain in 1719, and in 1720 Philip was compelled to renounce his claims and to withdraw from Sicily and Sardinia. The peace, however, brought no tangible gain to France, and increased the disorder of her finances.

That disorder had been aggravated by another cause. John Law, a Scotchman of

great ability, and still greater persuasive powers, half financier, half gambler and adventurer, established a bank in Paris which in 1718 became a royal bank. To this he added a company for the exploitation of the valley of the Mississippi. The issue of unlimited paper money, insufficiently backed by specie, and wild gamble in the shares of the company, led to something resembling the South Sea Bubble in England. Panic and a severe financial crisis followed. Law escaped from France in 1720, and the company was liquidated. The power of credit had been demonstrated and an impetus given to trade, but a wild spirit of speculation had been excited which aided in the general demoralisation.

In 1723 Louis XV. attained his majority. Dubois and the Duke of Orleans both died in the same year. The King, however, was only thirteen, and the real power was in the hands of the prime minister, the Duke of Bourbon, who chose for queen of France Marie, the daughter of the exiled King Stanislas of Poland, repudiating the late regent's engagement with an Infanta of Spain.

Peace and Retrenchment

In 1726 Bourbon was succeeded by the Venerable Cardinal Fleury, who gave to France a period of peace and retrenchment, which she sorely needed. He restored the finances, reduced taxation, constructed roads and encouraged commerce. Co-operating with Walpole, moreover, to keep the peace of Europe, he re-established good relations with Spain, but in 1733 he was forced by public opinion to support Stanislas in a war with Austria and Spain over the Polish succession, which resulted in Stanislas acquiring as compensation for the throne of Poland, Lorraine and Bar, which were to pass to France on his death.

In 1741 Fleury became involved in the War of the Austrian Succession. Defeated at Dettingen, the French won the great victory of Fontenoy and other battles, thanks to the talents of Marshal Saxe, but gained nothing at the Peace of Aix-la-Chapelle (1748).

Eight years of peace succeeded, during which French commerce flourished, and the colonies in America and the Indies were developed. But the King, though not without ability, was indolent and pleasure-loving. He was governed by his mistresses, the Duchess of Chateauroux and Madame de Pompadour, and, in the circumstances, no reform was possible.

In 1756 colonial quarrels, which had already led to local bloodshed, brought about war with England; while an Alliance with Austria involved France in the Seven Years War on the Continent.

The Pompadour's generals were disgracefully defeated, and the British Navy swept French commerce from the seas and crushed the French fleets. Worse still, Canada fell to Wolfe, and the French power in India was destroyed by Clive. The Treaty of Paris (1763) deprived France of nearly all her American and Indian colonies and left her exhausted and discredited.

Court Scandals

The scandals of the court continued, Madame du Barry, a beautiful courtesan, succeeded the Pompadour and drove from power the Duc de Choiseul, an able minister, who had formed the Family Compact, an alliance of all the Bourbon sovereigns (1761), acquired Corsica and suppressed the Jesuits in France.

The remaining years of the reign were marked by the suppression of the *Parlements* (1771) which broke the power of the magistrates and aroused serious opposition, by acquiescence in the first Partition of Poland, by grievous monopolies of grain, ruinous taxation and acts of national bankruptcy.

In 1774 Louis died full of years and dishonour, bequeathing to his successor an immense deficit, a disorganised administration, a defective army, and a people rendered desperate by misery and seething with discontent.

He was succeeded by his grandson, Louis XVI., a well-intentioned and inoffensive Prince, who sincerely desired the good of his people, but lacked the necessary intelligence and strength of character to achieve real reforms. His Queen, Marie Antoinette, the youngest daughter of Maria Theresa, was spirited and generous, but very indiscreet, headstrong and ill-educated. The misfortunes of the Seven Years War rendered the Austrian Alliance unpopular, and her inability to understand French character made her personally disliked.

The new King began well by summoning to his councils Malesherbes and Turgot, two of the best and ablest men in France. Turgot, who became Controller of Finances, not only swept away financial abuses and effected great economies, but abolished forced labour, removed many of the restrictions on commerce and industry and founded the *Caisse d'Escompte*—practically a National Bank.

From the portrait by Mme. Vigée-Lebrun, at Versailles.

From the portrait by Callet, at Versailles.

QUEEN MARIE ANTOINETTE AND KING LOUIS XVI.,

around whom the most magnificent of European Courts tottered and fell. The King, a well-intentioned, inoffensive Prince, perished on the guillotine, January 21, 1793. Ten months later the guillotine also claimed his spirited, generous, but ill-fated Queen.

He would have proceeded to still further reforms both in finance and administration, had he not incurred the enmity of the Queen, the privileged classes, whose immunities he threatened, and the *Parlements*, which had been restored. The King was too weak to support his ministers against such opposition,

From the portrait by Alix.

VOLTAIRE (1694–1778),

whose biting sarcasm and masterly destructive criticisms did much to shake the faith of his fellow countrymen in all existing institutions.

and both Malesherbes and Turgot fell from power. The abuses which they had removed, were then mostly revived ; but when France, with little provocation, decided to support the American colonies against England, it became necessary to find an able minister, and the Swiss banker, Necker, was raised to power.

Necker, a sound man of business, was not a great statesman. He effected many useful reforms and economies, but he lacked ability to cope with such a situation as that presented by French finances and administration. Yet his fall, occasioned by the anger of the court at his publication of a financial statement—publicity being fatal to corruption—was a real national calamity.

Meanwhile, the war with England had added £50,000,000 to the public debt. The war was, on the whole, successful for France. The fleet, under de Guichen, d'Estaing and de Grasse, did well and played an important part in the liberation of the colonies; whilst de Suffren outclassed his opponents in the East Indies.

By the Treaty of Versailles (1783), France regained Chandinagore, Pondicherry and the West Indian Islands, which she had lost, but she won no actual gains. She had, however, renewed her prestige.

Commercial Treaties were made with England (1786) and Russia (1787). Lavoisier and others raised the fame of France in science, La Pérouse in navigation. The Royal Society of Medicine (1780), the School of Mines (1788), the enlargement of the Academy of Sciences (1787), gave an impetus to research and material progress. But beneath all this political and scientific accomplishment, the catastrophe of the Revolution was drawing nearer ; and before proceeding further with our narrative it will be convenient to attempt a brief survey

From the portrait by Latour.

ROUSSEAU (1712–78),

the philosopher whose writings and bold assertions of the claims of majorities against the authority of Governments profoundly influenced the French Revolution.

of the conditions which rendered such a catastrophe inevitable.

The consolidation of the power of the Monarchy by Henry IV., and afterwards by Richelieu and Mazarin, had established territorial and governmental unity at the cost of an excessive centralisation of power. The well-known saying of Louis XIV., "*L'état, c'est Moi*," was a literal expression of the truth. The power of the nobles had

been crushed and those checks which limited the prerogative in England—the control of supplies by Parliament, firmly established customs, an independent judiciary and the political influence of the middle class—had no existence in France.

The States-General had not met since 1614. All legislative and administrative power were concentrated in the hands of the King and the Royal Council. While Henry IV. devoted himself to securing the welfare of his people, the great ministers of Louis XIV., Colbert and Luvois, aimed at enriching France only to increase the power of the King.

Louis himself was an indefatigable worker and had high ideas of kingly duties, but the welfare of the country came to be more and more identified with the prestige of the dynasty and the splendour of the court. Even the reforms undertaken under such a system tended to increase the bureaucratic officialism which everywhere stamped out freedom and initiative. Whatever was done for the people, nothing was allowed to be done by them.

Under Louis XV. the same system was continued without the ability which had in part redeemed it. The shameful indolence of the King, the open vices of the court—which rendered policy subservient to the caprices of abandoned women—the unsuccessful wars and the unpopular alliance with Austria, hopelessly lowered the prestige of the government.

The frightful state of the finances has already been referred to. Taxation was oppressive and ill-distributed. The nobles were largely exempt and the burden on the clergy was light. The chief weight fell on the middle classes, and above all, on the peasants. The farming of the indirect taxes to grasping capitalists led to shameful extortion in their collection and robbed the government of half the produce. The secrecy which surrounded the finances, the lack of any check and the absence of proper accounts opened the way to every kind of abuse, corruption, leakage, the sale of offices, and pensions granted for services not rendered.

Commerce and industry were hampered by a multitude of repressive regulations. Monopolies were frequent. Close corporations

From the painting by Baron Jolly.

BENJAMIN FRANKLIN AT THE COURT OF LOUIS XVI.

Franklin's mission to Versailles (1778) was a very delicate one, for the French Government was not then prepared openly to side against Great Britain. Participation in the War of American Independence greatly encouraged the growth of liberal ideas in France.

governed the trades. Internal customs-houses levied dues on the frontiers of the provinces. Merchandise passing down the Saône and Rhine from Gray to Arles had to pay toll no less than thirty times. Agriculture suffered from the great amount of land in the possession of the Church, from ruinous land taxes, forced labour, restrictions on trade in grain, and the multitude of seignorial rights, especially those relating to game.

Law was complicated and uncertain. Besides the *Parlements* and other royal courts there were remains of feudal jurisdiction, ecclesiastical, seignorial and municipal courts. There was little common or codified law. Over three hundred different bodies of law were in force in different districts. The area subject to the different courts varied greatly, and men often had to go far for justice.

The penal code was savage and permitted secret examination and torture. Magistrates were unpaid or ill-paid, and lived on exactions from litigants. The power of the King was above the laws and interest at court overrode justice.

Alongside with these abuses, a spirit of inquiry and criticism had grown up. While there was neither liberty of conscience nor freedom of the press, speculation upon abstract questions was widespread. Even under Louis XIV. Vauban had written on economic and Fénelon on political reform. Under Louis XV. inquiry became bolder.

Voltaire and Rousseau

Voltaire (1694-1778) assailed social abuses with biting sarcasm, and his onslaught on the Church developed into a general attack on Christianity. A master of destructive criticism, he did much to shake men's faith in all existing institutions.

Montesquieu (1689-1755), who had prepared the way with his *L'Esprit des Lois*, held up the British Constitution as a model. Rousseau (1712-1778) asserted the claims of the individual and the rights of majorities as against the authority of governments. Diderot and the Encyclopædists, while they fought for enlightenment and liberty, assailed the very foundations of faith and morals. Quesnay, the Marquis de Mirabeau and others established the study of economics.

Such writers found many to listen to them among the *bourgeoisie*, from whom the leaders of the Revolution came. The developments of industry and commerce had created a large middle class who, while they owned nearly all the capital of France, found themselves excluded from the Army and Navy by the *noblesse* of the sword, and from the judiciary by the *noblesse* of the robe. While any rich citizen could easily purchase a patent of nobility, the ennobled *bourgeois* found himself ill at ease among the old aristocracy. They resented the constant official meddling with trade and the lack of business government, and longed for a voice in public affairs. The participation of France in the War of American Independence encouraged the growth of liberal ideas.

Meanwhile the nobility, deprived of responsibility and—except for military service—of employment, were divided amongst themselves. The poorer nobles lived hardly and uselessly in the country; the richer were attracted to the court, where they formed a witty and elegant but frivolous and immoral society.

The conditions of the peasants varied in the different provinces. The hired labourers were fairly paid, but the great mass of the peasant proprietors and copyholders were in a wretched condition. They enjoyed a personal liberty unknown in lands where serfdom still flourished, but they were cruelly overtaxed, and the surviving feudal rights and dues, though less onerous than is sometimes supposed, were vexatious and burdensome.

A Tottering Throne

Education was widely diffused and good among the middle class, but partial and elementary among the peasants. The Church had lost ground through the attacks of the philosophers and its own abuses. The superior clergy were often very rich and were largely tainted with the prevailing scepticism. The parish priests were poor and ill-educated but generally pious, hardworking and of democratic sympathies. The religious orders were mostly in a state of decay.

On the whole, the condition of the middle and lower classes was better than on the great part of the continent. But it was just the spread of personal freedom, of education and enlightenment, which made the lack of representation and the corruptions of the government so galling.

The civil service and the justiciary under Louis XVI. were above the average of their time, and administration was growing more reasonable and sympathetic. But the vices of the social order were too deep-seated to be removed by any but drastic remedies.

The French Monarchy perished because it had fostered material and intellectual progress unaccompanied by a corresponding political development. J. B. S.-B.

Continued from page 336.

SCIENCES:

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ELECTRICITY AND MAGNETISM.—XXIII

Electroscopes.—When an insulated conductor is charged with static electricity either of the positive or negative kind, the presence of such a charge may be indicated by means of a simple device known as an Electroscope.

Disconnected small pieces of paper such as those used in the previous simple experiments act as an electroscope, but since they adhere to the electrified body they do not form a convenient arrangement for indicating the presence, kind, and amount of an electric charge. More suitable forms of apparatus must be employed for this purpose, and the simpler of these are the pith ball and gold leaf electroscopes. The former consists of a small sphere of elder pith suspended and insulated from its supports by means of a fine dry silk thread. One can easily be constructed by means of a thick wire support stuck into a wooden base. The length of silk thread used should not be sufficiently long to allow the pith ball to come in contact with the vertical part of the wire, when the ball swings about as the result of electrical repulsion.

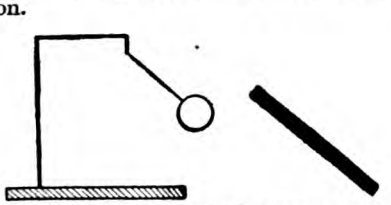


Fig. 80.—The pith ball electroscope.

Experiment 76.—*To charge the electroscope, and to determine the sign or kind of a charge of electricity on another substance.*

Electrify a rod of sealing wax by rubbing it with flannel. Bring the charged sealing wax near the pith ball and notice the effect of a force of attraction between the two. Allow the ball to touch the wax. There is now a force of repulsion between the two since the wax has given a small charge of electricity to the pith ball, and the kind or sign of the charge on the latter is negative, since sealing wax is negatively charged when flannel is used as the rubber.

Rub a piece of glass with fur and bring the charged glass near but not touching the electrified pith ball. Repulsion occurs, showing that the kind of electricity on the glass is negative.

Experiment 77.—*To discharge the glass rod.*

Draw the glass rod through the hand. Bring the glass near the pith ball. Is there any force of attraction? This shows that the glass has lost its negative charge, but does not prove whether it is entirely discharged or possesses electricity of a positive kind. Now touch the pith ball with the hand, and again bring the glass near it. There is now no force either of attraction or repulsion. Both the glass and the pith ball are discharged, i.e. they possess no electricity of either kind.

Two very important facts are learned from this simple experiment:—(1) Electrified bodies may be

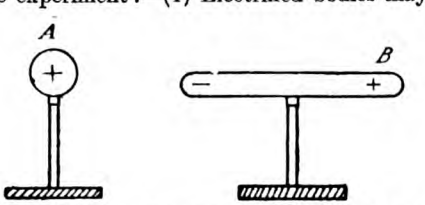


Fig. 81.—Types of insulated conductors required to investigate electrostatic induction.

discharged by connecting them with the earth through the person of the operator, and (2) repulsion is the true test of electrification. Electrified objects may be "earthed" by their coming in contact with water pipes, wires, or even the table or other articles in the room, hence the success of our experiments depends very largely upon the proper insulation of charged conductors. As a rule spherical brass conductors, or those composed of wood and covered with tin foil, are mounted on wooden bases but separated from the latter by glass rods.

The student should construct conductors of suitable dimensions, about the sizes of large and

small marbles and of a tennis ball. Such conductors may be made of wood covered with tin foil and mounted on thick pieces of sealing wax if glass rods are not available. They need not all be of spherical form, but the ends must in all cases be rounded since edges and points allow electricity to escape. Fig. 81 illustrates the kind of thing that should be made.

The Gold Leaf Electroscope.—In its usual form this little instrument consists of a brass rod, the upper end of which is connected to a round metallic disc, while to its lower end is attached a metal crosspiece supporting two flat pieces of Dutch metal (gold leaf) hanging with the face of one opposite and parallel with that of the other. The brass rod passes through a wooden cap that fits into a glass jar containing the gold leaves and the greater part of the rod. When the electroscope is charged with either positive or negative electricity the leaves being charged with the same kind of electricity repel one another, hence they diverge as illustrated in the figure.

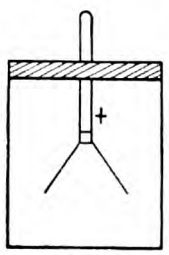


Fig. 82.—Gold leaf electroscope.

A simple home-made instrument may be constructed from a small glass jam pot, a piece of wood to fit its mouth, and about three inches of thick copper wire the ends of which are carefully rounded off by means of a file and emery paper. If the lower part of the copper wire is bent at right angles a single piece of Dutch metal can be bent over the cross piece, and so form the two "leaves" of the apparatus.

Experiment 78.—*To charge the gold leaf electroscope by contact.*

Electrically excite a piece of glass tubing by rubbing it with dry silk. Touch the upper end of the brass rod of the electroscope with the charged glass. What happens to the leaves and why? Now bring near, but not touching the upper end of the electroscope, a piece of sealing wax that has been electrified by rubbing it with flannel. What happens to the leaves of the instrument? The positive electricity previously given to the electroscope is attracted to the upper part of the apparatus and held there by the negative electricity on the sealing wax. While the wax is near the instrument, touch the upper end of the brass or copper rod with the finger, remove first the finger, then the sealing wax. The leaves diverge as before, showing that the charge of positive electricity is still on them although you have "earthed" the instrument by touching it. The electricity was held in the instrument in spite of the connection with the earth.

Electricity thus held by the influence of a separate charge of the opposite kind is said to be "*bound*," but electricity which escapes when a conductor is connected either to the earth or to another conductor is called "*free*" electricity.

Electrostatic Induction.—When studying magnetism we found that pieces of iron and steel situated near, but not touching, a magnet themselves became magnetic by influence or induction. Similarly a current of electricity may be used to induce another current in a circuit distinct from that of the first. Both magnets and electric currents exert their influences through their respective fields or the regions around them, and in electrostatic induction we may observe phenomena which are in many ways similar to those of magnetic and current induction.

Let us consider the case of a charged insulated spherical conductor, A (Fig. 81). The region extending in all directions around A is called the electric field of A, since the influence of the electricity on the conductor extends through that region. Now if another insulated conductor B is brought within the "field" of A, the positive charge on A influences B in such a way as to attract negative electricity to the nearer side of B and repel positive electricity to the further side. Now if *any* part of B is earthed by touching it, the free positive electricity disappears, but the bound negative electricity remains on the conductor, held there by A's positive charge. On taking A away from B, the latter may be tested by means of an electroscope. The student who has constructed simple insulated conductors may easily charge them in this way. *Such a process is called charging by induction.* The first or initial charge may be given to A by means of a simple piece of apparatus called the electrophorus.

The Electrophorus.—This instrument is very suitable for the production of small charges of electricity. In its usual form it consists of a circular flat plate of ebonite, the under surface of

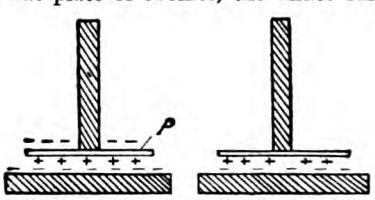


Fig. 83.—Illustrating the essential features of the electrophorus.

which is covered with tin foil, and a "cover" made of a circular metal plate attached to an insulating glass handle. The two essential parts of the apparatus can be easily identified in the figure.

A home-made electrophorus can be made by filling the lid of a cocoa tin with sealing wax, the surface of the wax being made as smooth as possible. The cover can be made from the lid of a tin similar to the first, and a stick of sealing wax should be used as an insulating handle.

In order to obtain satisfactory results the edges of the tin should be made as smooth as possible.

Experiment 79.—*To obtain an unlimited supply of positive electricity by means of the electrophorus.*

Rub the surface of the sealing wax in the tin briskly with a piece of warm dry flannel. The wax is now charged with negative electricity. Take hold of the "cover" by the insulating handle and bring the metallic plate to rest on the sealing wax. The electrical condition of the metal disk is now such that it is represented by the left hand diagram in Fig. 83. In reality a very thin film of air exists between the wax and the disk. The disk itself is subjected to the inductive influences of the charged sealing wax, so that positive electricity is held "bound" on the lower surface of the disk, while negative electricity is

repelled to its upper surface. Now touch the disk with the finger at any point p, in other words, earth it for a moment. Its free negative electricity disappears, leaving it charged with electricity of a positive kind. Its condition is now that illustrated by the right hand side of Fig. 83. On removing the disk from the base of the electrophorus, its charged condition may be tested by means of the gold leaf electroscope.

The positive charge on the disk can be employed to charge insulated conductors either by contact or by induction. In connection with this experiment, one or two important facts must be carefully noted.

(1) The electrophorus is a simple induction machine.

(2) An unlimited supply of positive electricity may be obtained from the disk provided that the negative electricity on the base does not escape.

Induction takes place through the non-conducting medium separating the conductor containing the inducing charge and the one being subjected to the inductive influence.

Specific Inductive Capacity.—Discussion of this matter will be understood better by further reference to Fig. 81. The inductive medium separating the two conductors is, in this case, air. Both the air and the conductor on the right are within the electric field of the charged conductor on the left. The air in this field is in a state of strain, and it is in virtue of this strained condition that the inductive effects are produced in the other conductor. The fact that the function of the medium is of great importance is proved by the varying degree of inductive effect produced when various substances compose the medium between a charged conductor and the surrounding bodies. Thus, when glass or sulphur is the medium the results are different from those obtained when air is the medium.

The capacity for induction, or that property in virtue of which inductive effects take place through various media, is termed *Specific Inductive Capacity.*

The capacity for induction of dry air is taken as unity, and it has been found that other substances such as glass, sulphur, mica, paraffin, etc., have greater inductive capacities than that of air. Any medium through which an inductive influence is exerted is called a *dielectric.* L. M. P.

BOTANY.—XVIII

51. Pollination by Insects. — Flowers which are wind pollinated are, as we have seen, small and reduced in various ways, so that they are hardly recognisable as flowers in the popular sense. This is of course due to the absence of a conspicuous perianth, which is a device to encourage the visits of insects and to ensure cross-pollination by their aid. The development of large and gaily-coloured corollas is the result of *natural selection.* Those flowers which are best adapted to the visits of insects are most likely to be visited, and thus to be pollinated and produce seeds. The inferior ones are most likely to be neglected, and thus to fail in the struggle for existence. This struggle is ruthless among plants, and the result of it is a gradual evolution which has eliminated the unfit, and has produced the remarkable adaptations to the individual needs of the plant, which makes us half ready to speak of a plant as having half-conscious aims and desires. Broadly speaking, we may say that a flower prepares itself for insect visits in three ways : by the show it makes ; by its shape ; and by its smell. In each case we have many examples of the preparation being perfectly adapted to its end.

Flowers make their display, in the first place, by means of a brightly coloured perianth or corolla. All colours are represented in the world's flora, and it is impossible to lay down any universal rules about them. In general, it is probably fair to say that purples and blues are characteristic of the higher and more specialised types ; while reds and yellows seem to be attractive to the inferior insects as well as to bees. White flowers are clearly more adapted to poor light than others : thus the white campion, but not the red variety, is visited by nocturnal insects. On such points as these, the student will accumulate his impressions by careful and persistent observation.

Many corollas are varied in colour, being plainly spotted or striped. The converging lines often seen in flowers act as *guide-lines* to the insect, and always lead it to the sweet juice which is the object of its visit. The presence of hairs is also noteworthy ; they may act as an obstacle or a trap for undesirable insects, as well as a directive guide to the more useful species.

Small flowers which, individually, would be inconspicuous often by association with others make an attractive show. This may be seen in lilac, elder, clover, daisy and numberless other cases. And even large flowers may have their effect greatly enhanced by their arrangement in an effective inflorescence.

An inflorescence may belong to one of two main types. It may be *racemose*, in which the main axis continues to elongate, giving off branches as it grows, so that the lower flowers are the oldest, and the central flower on the main axis is the last to open. On the other hand, the inflorescence may be *cymose*, in which the main axis first flowers and growth continues in the branches.

The various varieties of the raceme and cyme are shown diagrammatically in Fig.

124. In the raceme type we draw special attention to the *spike*, in which the flowers are sessile ; the *panicle*, in which each branch is itself branched into a raceme ; the *corymb*, in which the successive branches all arrive at approximately the same level ; the *umbel*, in which the pedicels all start at the same point ; and the *head* or *capitulum*, an umbel in which the flowers are sessile. The cymose inflorescence is generally looser in appearance than the raceme, but sometimes forms an umbel or corymb, as we can tell from the opening of the central flower first (Ramsons, Guelder Rose). In the campions and their relatives, the cyme is called *dichasial*, because the branches form in pairs from the opposite leaves. When the cyme is two-sided and not dichasial, it forms a *false dichotomy*, so named because the main axis seems to divide into two exactly equal branches.

The pedicel or flower-stalk often bears a little scale-leaf known as a *bract* ; and sometimes the peduncle bears one or more similar structures called *bracteoles* (Fig. 123). Generally these bracts or bracteoles were no more than scaly protections to the flowers in the bud ; but now and then they become noticeable and important. In the wood anemone, the peduncle bears three large leafy bracteoles ; and a whorl of similar structures forms a substitute for the calyx, which is petaloid, in the winter aconite. The arum lily and the spurge both have the bracts enlarged into the most conspicuous feature of their inflorescence, and some cultivated species of those forms have the bracts deeply coloured also.

Fig. 123.—Wood anemone, showing the three bracts.

While the colour of a flower is doubtless the main attraction to the insect, the shape also plays its part. Flowers which are in any pronounced degree zygomorphic can as a rule be entered usefully only by the more intelligent insects. The corolla of the snapdragon, for example, is two-lipped, but the lips are firmly closed, and the bee is the only insect that has the perseverance to find and open the mouth. The pea, the larkspur, the monkshood, the clover and many orchids are especially worthy of study in their relation to bees. The flower provides a suitable alighting stage, and otherwise helps the insect in its search for honey. Long-tongued insects are necessary in many actinomorphic flowers also. In the primrose the honey is at the bottom of a deep narrow corolla-tube ; and the insect, alighting on the expanded part of the petals, cannot reach it unless it has a long proboscis. On the other hand, flowers like the buttercup, which are quite open and whose honey is not concealed, can be pollinated by any insect that enters them.

The attractive smell of a flower is due to ethereal liquids known collectively as *nectar*. This is made in certain cells forming glands, in a specialised portion of the flower called a *nectary*. The nectary is a modification or special growth on one of the normal floral organs, and not generally a new and separate organ. It is usually situated deep down in the flower, so that the insect in searching for it is bound to get dusted with pollen and to brush against the stigma also. It may be formed on the receptacle, or on the stamens, or on the corolla ; and the nectar may be produced on one organ and collected in another. In the wallflower, the top of the receptacle has a ring of little green glands forming a *disk* ; the nectar secreted by these glands runs into a small pouch-like expansion of two of the sepals, and hence the bee has to probe the lowest point of the flower. In the pansy the nectar collects in the spur on the posterior petal, but is produced by a special appendage on the stamens. The stitchwort also makes its nectar at the base of the stamens. The larkspur produces its nectar in a spur of the corolla, but it flows into the larger spur of the calyx which surrounds it. In the buttercup the nectary is in the form of a little pouch at the base of each petal, and is easily found by any insect crawling about on the corolla. Certain flowers, like the common bedstraw, have their nectary on the upper surface of the inferior ovary.

Wherever it may be, the position of the nectar is the key to the behaviour of the insect-visitor ; and the student will find abundant pleasure, as well as instruction, in thinking out this behaviour for himself, in confirming his conclusion by observation and in admiring the contrivances by which the insect and the flower mutually benefit. We ought to add that a few conspicuous flowers produce no nectar ; they are visited by bees, however, for their pollen, which they produce in abundance. Examples of such *pollen-flowers* are the wild rose, rock rose and clematis.

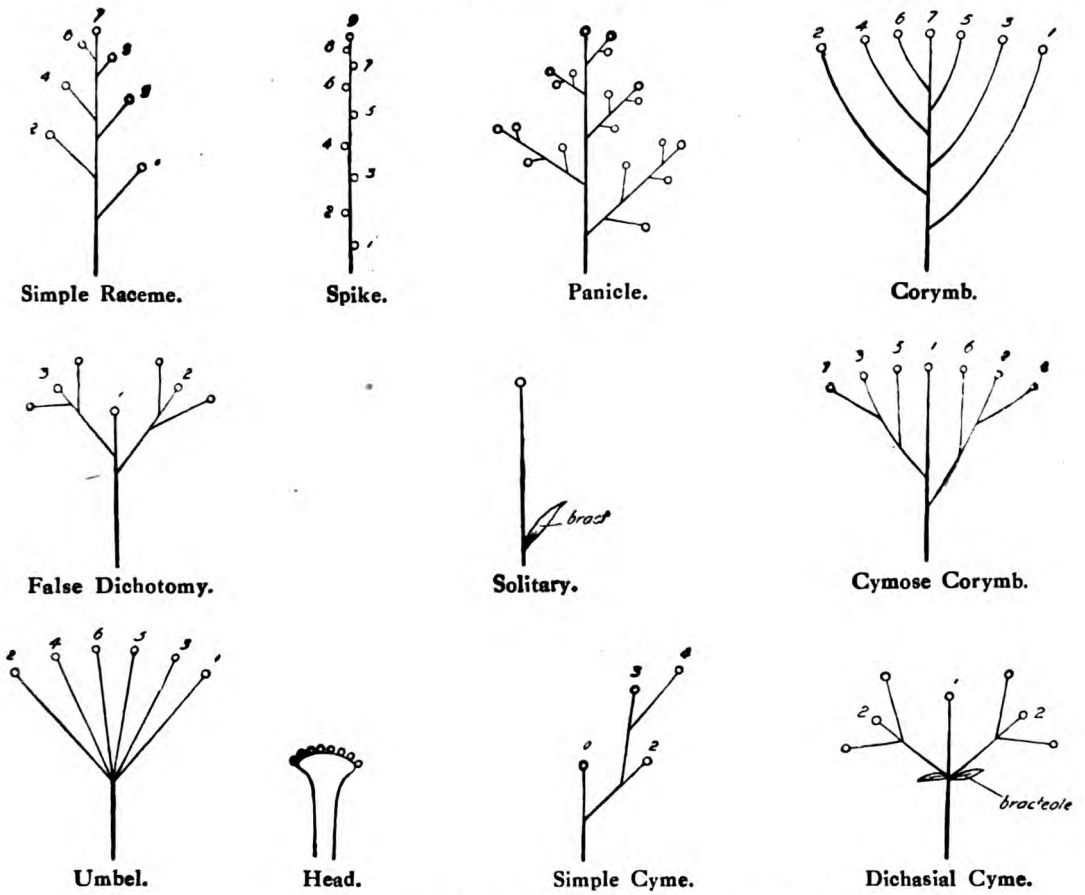


Fig. 124.—Illustrating diagrammatically the various types of the Raceme and Cyme.

52. Special Cases of Insect Pollination.—We here apply the general considerations of our last article to a few special cases, reserving others for brief treatment in later lessons.

1. The *Arum Lily* (Lords and Ladies) is an example of pollination by carrion flies, for which it provides a carrion-like odour. Its inflorescence is a special variety of spike known as a *spadix*, and is almost entirely enveloped in a large green or coloured bract called the *spathe*. The axis of the spadix is swollen, and terminates in a prolonged club, generally of a red colour. Round the lower part of this fleshy axis the flowers are closely aggregated. They form three groups, in which the lowest flowers are female and contain ovaries only ; the intermediate flowers are male, having nothing but anthers ; while those of the upper group are sterile and are in fact little more than hairs. It is clear that small carrion flies, crawling about on the axis, may easily carry pollen from the male to the female flowers.

2. Flies and small beetles are the chief pollinating agents in many members of the groups Compositæ and Umbelliferæ, which are also pollinated by bees. The flowers in these families are small, and grow in compact heads or umbels ; and it is easy for any insect to creep about on the tops of the flowers without attempting to appropriate the nectar. As the anthers just reach the mouths of the flowers, and the mature stigmas protrude beyond them, it is evident that cross-pollination of flowers in the same head or umbel may occur. It may be well observed in daisy, oxeye, mayweed, yarrow, hogweed, angelica, and other similar plants.

3. The *speedwell* is especially pollinated by the hover-fly (Fig. 126). The gamopetalous corolla forms a tube of no great depth, and the two stamens of the flower stand out prominently. When the insect alights on the corolla, he grasps the two stamens with his legs and uses them thus as his support in his search for the nectar. In so doing he is dusted with pollen, some of which may be brushed on to the stigma of the next flower visited.

4. The *honeysuckle* is an example of a

flower pollinated by moths, especially at night, when it is most fragrant. Moths and butterflies have fairly long tongues, and hence can reach the nectar at the base of the deep and narrow corolla-tube. Moths do not need to settle on the flowers they visit; they merely hover in front of them. Consequently, the honeysuckle provides no alighting stage, and its anthers and stigma hang loosely well in front of the flower (Fig. 128). Other flowers which are pollinated in the evening are the evening primrose, convolvulus, and tobacco plant, which are either white or yellow. In the daytime moths and butterflies seem to have a good sense for red as well as white flowers, and they often pollinate the red campion and the pink ragged robin.

Fig. 125. — Spadix of Arum.

5. Wasps are not very industrious insects and do not play a very important part in fertilisation. But they seem to pollinate heather sometimes and *figwort* frequently. The

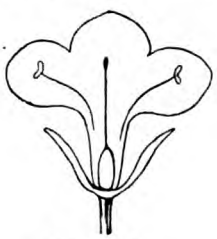


Fig. 126.— Speedwell.

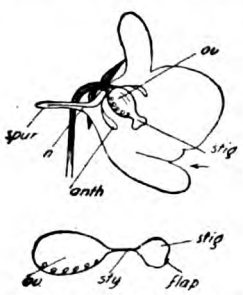


Fig. 127.—Diagram showing how the Pansy is pollinated by bees.

latter is a tall square-stemmed plant with small, dark-coloured, two-lipped flowers which are protogynous. The wasp which has visited a stamen flower is dusted with the pollen on the underside, some of which may be brushed off by the stigma of a flower in the female stage (Fig. 129).

6. The *pansy* is a good example of a flower pollinated by bees. The bees are the best agents of pollination, because they are exceptionally industrious and also because they confine their activities to one kind of flower at a time (Fig. 127). In the pansy, the bee alights on the anterior petal and tries to get at the nectar in the spur of the posterior petal. In doing this, his proboscis brushes pollen from the anthers which form a kind of cone round the styles immediately in front of the entering bee. The stigma is knoblike, and only a small portion of its surface is sensitive. This sensitive spot has at the bottom of it a little flap, so disposed that the proboscis of the bee cannot rub against the sensitive surface as it withdraws from the flower, but only as it enters.

7. The *orchids* have the most elaborate mechanism of all. The special features of these flowers depend on the large modification of the posterior petal of the perianth; the remaining five are but slightly modified, if at all. The modified petal assumes a great variety of shapes, and is known as the *labellum* (*lab.*). Owing to a twist of the inferior ovary during growth, the labellum seems to be anterior: this twist must be remembered in drawing a floral plan, because it displaces all the organs that grow on the ovary. The short filaments and styles are

Fig. 128.—Honeysuckle—an example of a flower pollinated at night by moths.

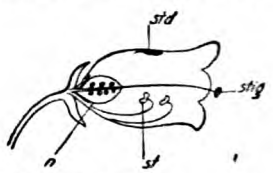


Fig. 129.—Figwort—showing stamens unopen.

std = *staminode or sterile stamen.*

fused together into a stout *column*, on the top of which are to be seen one anther and two stigmas. When ripe, the anther dehisces along two slits and discloses the pollen in the form of two club-shaped masses, the *pollinia* (*poll.*). Each of these pollinia expands at the base, and is caused to adhere to a *beak* (*b.*) (Fig. 130) above the stigmas by the secretion of a special gland.

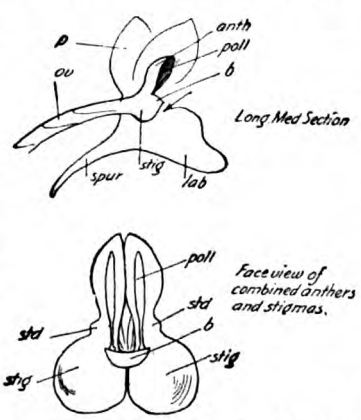


Fig. 130.—Illustrating the elaborate pollination mechanism of an Orchid.

As the bee enters the flower its proboscis catches the beak and the pollinia are detached whole and stick out upright from its head. Almost at once the stalks of the pollinia curve forward, so that they fall forward into the horizontal position and are thus exactly in the right position to be rubbed off on the stigma of the next flower visited. E. W. E.

GEOLOGY.—V

Formation of Snow and Ice.—In many parts of the world the temperature of the air falls below the freezing point of water, 0° C. or 32° F., and instead of rain the atmospheric precipitation falls as snow or hail. Lakes and rivers become coated with a crust of ice, which is able to float, since its specific gravity is less than that of water. The sea may also become frozen over, although it must be remembered that the freezing point of salt water is considerably lower than that of fresh. The conditions which favour low temperature are high latitudes and high elevation. The polar regions are capped with sheets of ice of continental dimensions, and the highest mountains of the globe, even at the equator, are held in the frozen grip of ice and snow. The fact that water expands on freezing is responsible not only for the bursting of pipes and the splitting of trees, but also for the shattering of rocks along joint planes, fissures and crevices. In temperate regions frost serves a useful purpose to the farmer by breaking up and disintegrating hard soils.

Snow-fields.—Accumulation of snow requires not only a low temperature, but also a heavy precipitation of moisture. Some of the coldest regions of the earth, such as Eastern Siberia, are free from permanent snow, because the winter falls are so small that they are easily removed during the spring and summer. If, on the other hand, the snow-fall of winter is greater than the amount thawed in the summer, a permanent snow-field is established. The *snow-line* is the level of equilibrium between winter accumulation and summer removal, and its relation to latitude is strikingly indicated by the following examples :—

Antarctica and Greenland	Sea level.
Central Norway	5,000 ft.
The Alps	8,000 ft.
Kenia and Kilima Njaro, Equatorial Africa	16,000 ft.
Andes, Equatorial America	18,000 ft.

The flakes of snow which collect above the snow-line gradually become consolidated into a granular form known as *névé* or *firn*, and this in turn, as it is buried still more deeply, grades into porous ice.

Avalanches.—In steep mountain districts the piled-up snow may become unstable, either because it fails to adhere to the slope, or because, in the spring, a thaw sets in and melts the lower layers. The whole mass then becomes detached and slides down, carrying with it loose soil and rock and sweeping away any obstructions that lie in its path. Avalanches are in many localities of annual recurrence, and as they follow the same track year after year, their floors become smooth and striated, and where they end their wild rush, large screes of angular debris are deposited.

Glaciers and Ice-sheets.—The névé which yearly collects above the snow-line does not usually drain away in the catastrophic manner of an avalanche. More commonly it serves as the feeder of long tongues of transparent granular ice which are slowly pushed out along the valleys. Such streams of ice are called *glaciers*, and are to be found in all high mountain districts. They occupy the valleys, are bordered by the upper slopes of the mountains, and are in many respects strictly comparable to rivers. If, however, the surface of ice accumulation is a high plateau, the ice flows away more or less equally in all directions, burying the country beneath a vast ice-sheet. Such giant glaciers reach continental dimensions in the case of Greenland and Antarctica, and are known, in contradistinction to valley glaciers, as continental glaciers or ice-sheets. Smaller masses of the same kind are called ice-caps, and are common among the Arctic islands, notably Iceland and Spitzbergen.

Flow of Glaciers.—Since ice is a crystalline form of water, and since crystals are rigid and not plastic, the curious phenomenon of ice flowage calls for a short explanation. It is well known that pressure lowers the melting point of ice. A skater, for example, really glides over a narrow film of water formed by the intense pressure under his skates. It is due to this behaviour that ice is able to act like a plastic substance. Glacier ice is made up of an immense number of granular crystals, and under the pressure of the snow-field above and the influence of gravity below, it happens that certain parts of the grains are ground together until melting takes place at the contact, and a film of water slips out and re-freezes where the pressure is less. Thus the granules can move over one another and the ice as a whole appears to flow.

A glacier can therefore accommodate itself to its bed. Where the valley is wide it swells out; where it is narrow the glacier withdraws into the gorge. Over a steep slope in the valley floor the glacier tumbles in the shattered blocks and pinnacles of an

ice-cascade, regenerating itself at the bottom and flowing slowly away as before. The rate of movement varies from about 1 foot a day to as much as a hundred feet, but the latter figure is very exceptional. The middle of a glacier flows more quickly than the sides, which are retarded by the drag and friction of the rocks. This sets up a system of stresses which are relieved by the formation of crevasses pointing up stream at about 45° to the valley. The more rapid movement of the upper layers of ice over the lower is responsible for a banded structure which is often seen in vertical faces of glacier ice. Glaciers flow more rapidly during the day than at night, and also during the summer than in winter. This is due to the fact that ice expands considerably with increase of temperature, and the force due to expansion augments the normal flow due to gravity.

Moraines. — The mountain slopes between which glaciers flow are often lined with screes due to the breaking up and shattering of the rocks by frost and other agents of denudation. Material of this kind ultimately finds its way down to the surface of a glacier, and as the latter moves down the valley each of its sides becomes streaked with a continuous ribbon of rock debris known as a *lateral moraine.* When two glaciers from adjacent valleys meet, the inner moraines are united as the glaciers continue their journey side by side and a *medial* moraine is thus produced. Much of the rock waste carried on the surface of a glacier is swallowed up in fissures and crevasses in the ice, and may reach the sole of the glacier, where, in company with material worn from the rocky floor, it constitutes the *ground moraine* (Fig. 39).

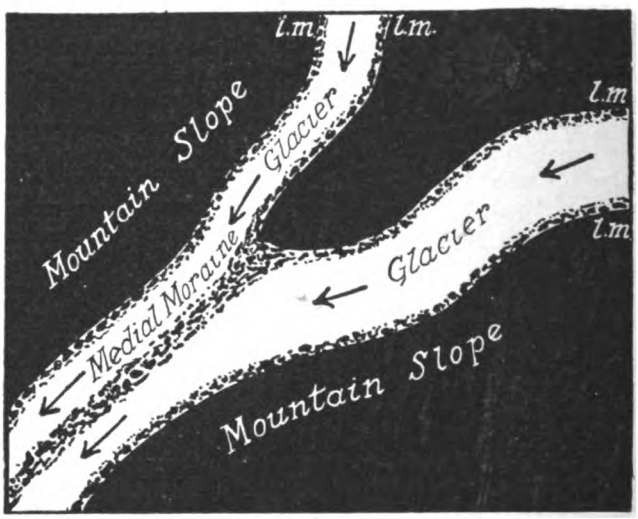


Fig. 39.—The sides of a glacier become streaked with continuous ribbons of rock debris known as lateral moraines (l.m.). When two glaciers meet, the inner moraines unite, producing a medial moraine.

This material is forced along the bottom by the moving ice above, and the floor thus becomes grooved and polished. The stones and boulders themselves are worn down and striated. All rough edges and obstructions are ground down into a fine rock-flour which serves to polish still more smoothly the rocks below. Finally, all this material, angular stones, polished and striated stones, fine mud, and clay, arrives at the termination of the glacier, where it is dumped down across the valley in a ridge known as a *terminal moraine.*

Glacial Erosion. — It is, from the nature of the case, impossible to study the erosive action under existing glaciers. However, as we shall see, there are a large number of features in many of the landscapes of the British Isles which indicate that at no very remote date vast glaciers occupied all but the southern limits of our country. It thus happens that the effects of glacial erosion can be seen at hand. It is obvious that a glacier, heavily charged with rock debris, will move over the land like a gigantic rasp, dislodging or grinding down all irregularities of the surface, ploughing into the softer rocks, abrading and polishing the harder ones, rounding off large hummocks of rock, wearing away projecting spurs from the mountain-sides, and in general reducing the angular outlines of the landscape to softly rounded forms. The V-shaped valleys of sub-aërial erosion are deepened and widened by the abrasion of mountain glaciers, and transformed into U-shaped troughs. Tributary valleys on either side of a main valley are eroded to a much less extent, and consequently when the glaciers retreat, it is found that the floor of the main valley is at a much lower level than those of the lateral valleys, which have been cut across by the erosive power of the main glacier, and are thus left with their mouths high up on the mountain slopes. Such valleys, the streams from which descend in cascades or waterfalls, are known as *hanging valleys.*

Corries and Corrie Lakes.—At the head of valleys formerly occupied by glaciers it is usual to find a circular basin with steep sides reaching up to the mountains behind. This is called a corrie or *cirque*, and in the scooped-out floor one or more corrie lakes occupying small rock basins may be found. The corrie has been formed by the cutting back of the original head of the valley. Above the ice, and at the bottom of the fissures and crevasses which are so common near the precipitous source of a glacier, the rock face becomes intensely fractured during the summer by the daily melting of the snow and ice, and the powerful expansion due to the nightly frosts. Angular masses of shattered rock are thus dislodged, and are carried away both on the surface of the ice and at the bottom. So the rocky walls of the valley head are eaten back year after year until a steep-sided corrie is dissected out of the heart of the mountain. Under the most intense glaciation corries of neighbouring valleys may approach one another till only precipitous ridges or *arêtes*, and sharp, pyramidal peaks remain. The floor of the corrie is subject to a greater pressure and scouring action than the rest of the valley, owing to the greater head of snow and ice forcing down on it from above. Thus it often happens that a shallow rock basin is scooped out by the glacier, and this, when the ice has withdrawn, may become a corrie lake.

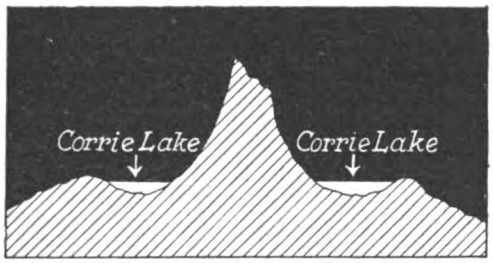


Fig. 40.—At the head of valleys formerly occupied by glaciers, it is usual to find a circular basin with steep sides reaching up to the mountains behind. This is a corrie; and in the scooped-out floor one or more corrie lakes may be found.

It is more commonly found, however, that the retreating ice leaves a crescentric ridge of

Photo: D. McLeish.

GRAND PARADIS (13,324 ft.),
the highest of the Italian Alps, showing the great Tribulation Glacier.

moraine, which dams in the water on the outlet side.

Piedmont Glaciers. — When a number of glaciers emerge from the valleys to the lowlands, they unite and spread themselves out like a fan. Such a vast expanse of ice is called a *Piedmont glacier*, for the plain of Piedmont was occupied by a glacier of this kind during the Ice Age, owing to the confluence of the great mountain glaciers which came down from the Alps. The best modern example is to be found in Alaska, where the Malaspina glacier, a magnificent nearly hori ontal plateau of ice, presents to the waters of Yakulat Bay a front of seventy miles. Much of the ice is stagnant, and elsewhere it moves with extreme sluggishness. So thick is the surface accumulation of debris around the edges that much of it is covered with forest, a graphic demonstration of the stagnant condition of the ice underneath.

Continental Glaciers. — With the exception of a coastal rim of mountains, the whole of Greenland is covered with an immense sheet of ice, which is slowly drained by numerous glaciers that find their way to the fjords.

A still greater continental ice-sheet—the greatest in the world—covers the south polar continent of Antarctica. Like that of Greenland, the Antarctic ice-sheet is covered with dry, finely granular snow, the atmosphere is generally clear, and radial winds, which often develop into the most furious blizzards, radiate from the polar regions towards the ice-bound coasts.

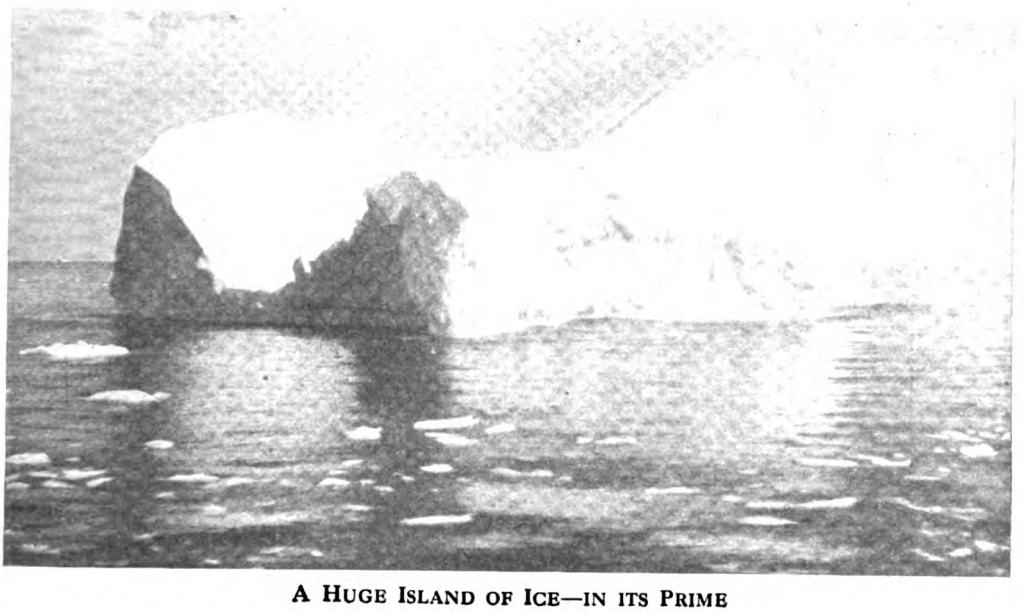
Icebergs. — When glaciers terminate at sea level, as happens in the polar regions, they break off in huge masses which float away as isolated *icebergs*. Owing to the fact that the density of ice is only slightly less than that of water, nine-tenths of the whole iceberg is submerged, the remaining tenth alone appearing above the surface of the waves. This proportion is subject to variation owing to the presence of caves in the ice which causes the berg to rise farther out of the water, and to the load of rock debris, which tends to sink the ice. This detritus is, however, gradually deposited on the sea bottom, and large blocks of stone may thus be carried far away from their original home. Icebergs are often shrouded in a dense veil of fog, and this, together with their tendency to topple over as melting and sea erosion proceeds, makes them exceedingly dangerous to shipping. Where the sea is shallow the ice may become stranded, and, moved about by the wind and ocean currents, large icebergs are able to grind away the deposits of the sea floor, which may thus become crushed and contorted.

Glacial Deposits. — Glaciers of the present day are known to advance and retreat alternately in a cycle of about thirty-five years, but the variation of movement is but slight. Towards the end of the Tertiary Period, however, glacial conditions were widespread over Northern Europe and America, which were buried beneath vast sheets of ice not unlike those of Greenland and Antarctica. As the ice finally retreated, which appears to have begun about 15,000 years ago, the rock materials which it deposited, or had previously deposited, were laid bare.

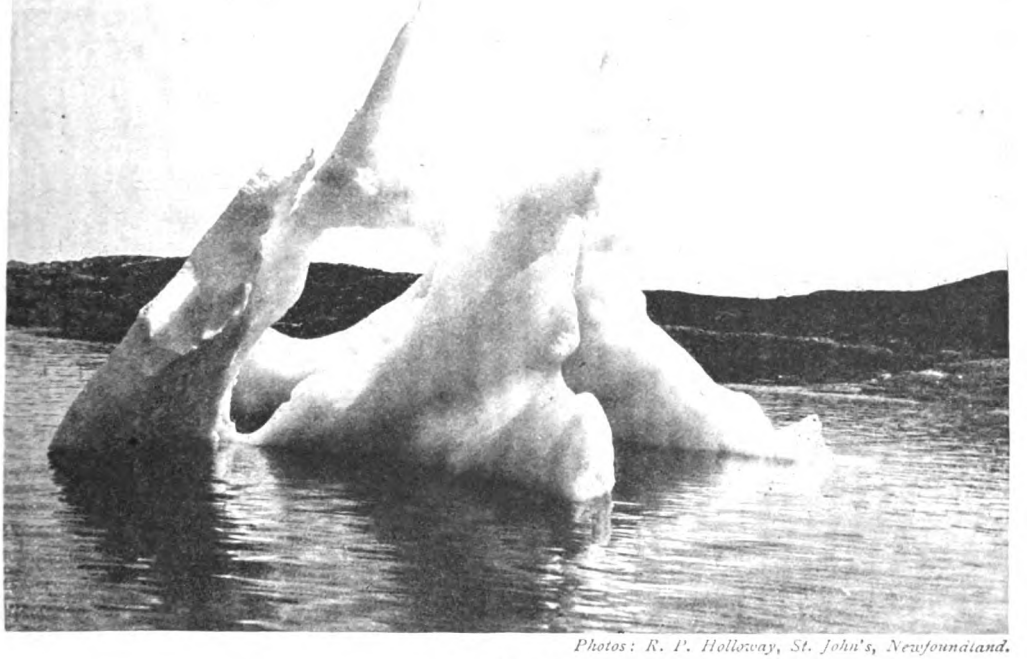
Now in the lower reaches of glaciers melting begins and streams flow over the ice or plunge into crevasses where they flow through the tunnels which honeycomb the lower layers of ice. Ultimately the water reaches the floor of the glacier, from which it finally drains away. The drainage of a glacier is therefore of three kinds: superficial, englacial, and subglacial; and owing to the rapid velocity of many of the streams, they are able to round off and transport much of the rock material encountered.

When finally the subglacial streams emerge from the front of the glacier their burden of debris is deposited and gradually spread out like a fan. In this way arises the *outwash fan*. At the front of the glacier itself a semicircular *end moraine* is formed, and if the glacier retreats in a series of steps, each one is marked by a similar ridge of end moraine. Inside the ridge a basin shaped depression is left which may be occupied in part by ground moraine, and this is frequently deposited in numerous elongated ridges, called *Drumlins*.

Boulder Clay.—The ground moraine of a great glacier consists of a fine rock flour in which are embedded subangular and sometimes striated stones and boulders of all sizes. Owing to the great pressure under which it lies this material becomes firmly compacted, and it is ultimately left behind by the glacier as the stiff, tenacious deposit known as *boulder clay*. The larger stretches of boulder clay have been produced by Piedmont glaciers and ice-sheets. When the materials have been sorted out by englacial and subglacial waters, fine clay, sand, and gravels may be separated from one another and laid down in irregular bands with normal boulder clay above and below. This association is very common in the glacial deposits of the British Isles.



A HUGE ISLAND OF ICE—IN ITS PRIME



Photos: R. P. Holloway, St. John's, Newfoundland.

—IN DECAY.

Icebergs have been surveyed weighing as much as 2,000 million tons. The density of ice being only slightly less than that of water, nine-tenths of an iceberg is submerged. To destroy an iceberg is beyond human power. None the less these huge islands of ice inevitably perish under the influences of sea erosion and melting in the warm water of their own creation (*cf.* Vol. II., pp. 160, 161).

Drumlins. — Drumlins are elongated mounds of boulder clay which may vary widely in size, but which have a characteristically hog-backed outline drawn out along the direction of ice flow. Where a large number of drumlins are grouped together side by side, as in Donegal and the Scottish Lowlands, they give rise to a surface which has been aptly described as like a "basket of eggs."

Kames and Eskers. — When a glacier terminates in standing water a delta is built up, this taking the place of the outwash fan on land. If, however, the ice-front is rapidly retreating, the subglacial streams deposit their load of sand and gravel in long, narrow mounds and ridges, elongated along the line of retreat. Similar winding ridges

Fig. 41.—Diagram illustrating the formation of *roches moutonnées*, the ice-moulded knobs commonly found in glaciated mountain districts.

and isolated mounds may be formed owing to the channels of subglacial streams having become choked with sand and gravel. When the ice melts curious drawn-out hills, which may reach a height of several hundred feet, are left behind. The isolated mounds are called *kames*, and the elongated ridges are known as *eskers*. It is not possible in every case to deduce their origin, but it is clear that they always mark the courses of glacial streams, for they exhibit well marked current bedding, and the sand and gravel of which they are built are typically water-worn.

Glacial Chronology. — The last continental glacier of Scandinavia advanced southwards across Jutland and North Germany. As it retreated it left a thin deposit of terminal moraine stretching across the Baltic and Southern Norway. Each spring and summer as the glacier thawed a great deal of sand and clay was liberated and deposited in the shallow sea which surrounded the retreating ice. The coarser material settled down at once, as a thin band of sand. In the autumn and winter, when the glacier froze again and the supply of sediment was withdrawn, the finer material slowly fell to the bottom, forming a thin layer of pure clay, sharply distinguishable from the coarser sediment below. The following year the glacier retreated to the north, and there again two well marked seasonal layers were deposited. Thus year after year the area of deposition moved northwards with the ice front, and the annual ribbons of sand and clay became superimposed one upon the other like wedge-shaped tiles on a roof. Baron de Geer has succeeded in counting the total number of annual bands which record the retreat across Southern Norway, and in this extraordinarily laborious but accurate way he proved that the time taken was 5,000 years. The Scandinavian glaciers are known not to have varied much during the past 7,000 years, and therefore it follows that 12,000 years have elapsed since the ice front reached the southern shores of Norway. Its retreat across the Baltic may be estimated at 3,000 years, so that we arrive at a total of 15,000 years as the period since the last great glaciation of Northern Europe.

Erratics and Perched Blocks. — *Erratics* are boulders of rocks which have been carried by glaciers far from their original position *in situ*. Fragments of the well-known Shap Granite have, for example, been found in the Vale of York and along the East Coast. Their course may be traced back across the Pennines through the Stainmoor Pass to their original home in Westmorland.

The Scandinavian ice-sheet which reached

Fig. 42.—Diagram illustrating the formation of the feature known as "crag and tail."

the shores of Britain brought with it and left there boulders of laurvikite and rhomb porphyry and other peculiar rocks known only in the Christiania district.

Perched blocks are large masses of rock which have been left by the retreating ice stranded upon a high ridge or mountain-side in an exposed or precarious position. A number of famous examples may be seen near Ingleborough in the Pennines and on the flanks of Snowdon in the Llanberis Pass. They are often far from their parent rocks, and in positions and elevations to which nothing but ice carriage could have brought them.

Roches Moutonnées. — An overriding glacier passing across prominent knobs of rock which it is unable to dislocate grinds them down into rounded hummocks. The side from which the ice came is generally smoothed down at a gentle angle and heavily striated. The lee side, however, is

usually steeper and unstriated, and it may even be rugged and entirely free from ice moulding. Such ice moulded knobs are known as *roches moutonnées*, and are common in glaciated mountain districts, especially on the floors and sides of valleys. It often happens that a prominent rock has served as a shelter in the lee of which glacial detritus has collected in a long tail gradually descending to the normal level. This feature is known as "crag and tail" (Figs. 41, 42).

Glacial Lakes. — In glaciated districts lakes of various kinds are a very common feature in the landscape. Corrie lakes due to the erosion of rock basins by the head of the glacier have already been described. Along valleys formerly occupied by glaciers soft rocks will have been scooped out more than hard ones, and above a strong rib of rock crossing the valley a lake is very commonly found. At the end of a glacier the crescentric terminal moraine frequently dams back the water so that a lake is formed. Temporary lakes are frequently formed owing to the damming back of water by a glacier itself. The drainage of a tributary valley may thus be held up, or even reversed if it should rise so high that the water can flow over a col in its upper reaches. The Parallel Roads of Glen Roy afford a famous example of this kind.

Evidences of Former Glaciation.—In the course of its history the earth has passed through several periods of extreme cold, when Arctic conditions invaded the temperate zones and even the tropics. Ice and snow have left their traces in grooved and striated surfaces, *roches moutonnées*, erratics, and perched blocks, kames and eskers, drumlins, terminal moraines, and boulder clay. U-shaped and hanging valleys, corries and scooped-out rock basins, lakes and ancient terraces, all bear witness to the vanished glaciers of the past. Relics of glaciation are still preserved in the Middle Pre-Cambrian of Canada, India, and perhaps Ireland, and in the Cambrian or late Pre-Cambrian rocks of India, China, and Australia.

During the Permian Period glaciation extended over South America, South Africa, India, and Australia. Finally came the so-called Great Ice Age, when all Northern Europe lay buried beneath an immense ice-sheet. Further south the Pyrenees, Alps, Caucasus, and great Asiatic ranges were each independent centres of glaciation, from which the ice descended in all directions far below the level of the present snow-line. In Canada and the United States the ice mantle spread out from three main centres—Labrador along the Atlantic, the Keewatin district along Hudson's Bay, and the Cordilleras along the Pacific Coast. In the tropics and in the Southern Hemisphere the story is the same. In Central Africa Kenia and Kilima Njaro supported glaciers which descended 5,000 feet below their present termination. In New South Wales, Tasmania and New Zealand, and in the Cordilleras and Andes of Patagonia and Chili the evidences of prolonged glaciation are equally clear. A. H.

METEOROLOGY.—II

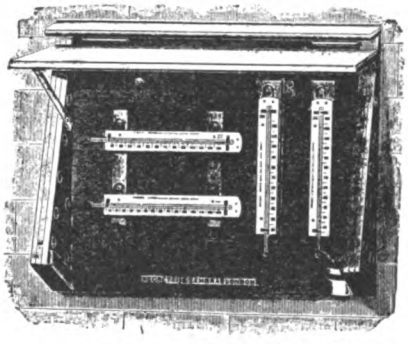
Sites for Screens.—In order that the thermometers shall be properly in communication with the general atmosphere, that is, with the air not unduly influenced by the presence of buildings, trees or other objects, the Stevenson screen should be erected in an open space, and the distance between any building, or other high object, and the screen must be at least twice as great as the height of the building or object. Also the site should consist of level ground bearing short grass if "standard" conditions are to be obtained, since the nature of the ground immediately underneath the screen affects the temperature of the air.

One of the most important facts concerning the temperature of the air is that the sun's rays pass through the atmosphere without heating it directly. The air receives heat from the land or sea upon which it rests, and to some extent from dust particles and condensed water vapour suspended in the air.

A person standing amid snow and ice on a mountain may be uncomfortably heated by bright sunshine, but the air around him is kept at the freezing point because it obtains its temperature from the snow and ice that it touches. If a thermometer be placed in direct sunshine, the number of degrees indicated by it does not measure the temperature of the air around it, but indicates the temperature of the heated thermometer itself. Hence the necessity of recording *shade* temperatures.

Concerning the matter of suitable sites for instruments, it may be noted that if an observer intends to investigate rainfall in addition to temperatures, a rain gauge should be placed south of the thermometer screen and at least ten feet away from it. A cheaper form of screen than the Stevenson pattern may be used attached to a wall, facing the north.

The regulations of the Meteorological Office permit observers to use this form of screen, though it is not as satisfactory as the Stevenson since it cannot be placed in so suitable a position, and it does not give the same protection to the instruments. A roof is not considered to be a suitable site for instruments, and should there be any



By permission of Messrs. Negretti and Zambra.

WALL THERMOMETER SCREEN.

Such a screen should be erected in an open space where the air is not likely to be unduly affected by the presence of buildings, etc.

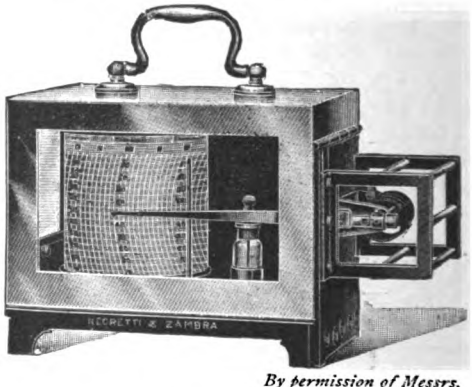
difficulty about the selection of a suitable position, the Meteorological Office is willing to give advice on any particular case. Communication should be addressed to the *Director, Meteorological Office, South Kensington, London, S.W.7.*

Record of Temperatures.—As punctuality is essential, precisely at * 9 a.m. (local time) and again exactly at * 9 p.m. a record of all thermometer readings should be made. The mode of entering the results depends upon the class of report that is to be made. Some stations submit a monthly report showing two readings per day ; others give three per day, the third being made precisely at* 3 o'clock in the afternoon. The morning and evening temperatures should be recorded thus :—

The numerals 1 and 2 in this form refer respectively to readings taken at 9 a.m. and 9 p.m. The word tenths signifies that in those columns results should be recorded correct to the nearest tenth of a degree, while the phrase whole degrees means correct to the nearest degree.

Instruments used to measure grass, sunshine, and earth temperatures will be described later when reference will be made to the columns for such readings in the table given above.

If the observer is doing official work for the Meteorological Office he will be supplied with report forms free of charge and he need not stamp his communications when forwarding reports. It must be clearly understood, however, that although the Meteorological Office does all it reasonably can do to encourage systematic work, it cannot *lend apparatus* except in special cases including ships which undertake to keep a meteorological log, certain fishing communities, and some out of the way stations where observations are of more than ordinary value.



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THERMOGRAPH.

A self-registering thermometer, by means of which a continuous record of changes of temperature may be made.

Temperatures may be indicated on charts

TEMPERATURES (DEGREES F.).

IN SCREEN.								IN OPEN.		IN GROUND.	
Dry.	Wet.	Dry.	Wet.	Maximum.		Minimum.		Grass Min.	Max. in Sun.	1	
1		2		To Evening.	Morning to next Morning.	Evening to Morning.	Evening to next Evening.	Evening to Morning.	Black bulb in Vacuo.	1 foot.	4 feet.
	Tenths			whole degrees						Tenths	

* Note :—Officially these times are written 9h., 15 h., and 21 h.

by ordinary numerals (*See* Geography, Vol. II., p. 290) but on a more comprehensive weather map temperatures are shown by means of lines called isotherms (Vol. II., p. 163). The value of isotherms is due to their showing the *arrangement* of air temperatures over certain areas at definite times; also the space between any two isotherms indicates the horizontal distance between places where the temperature differs by the number of degrees represented by the two isotherms. Thus we have represented on charts a *temperature gradient* somewhat similar to the barometric gradient in connexion with air pressures.

Reference to the map on this page will show that the average annual temperature gradient is much steeper in the S.E. counties of England than in Ireland.

The temperature of the air rises or falls so many degrees, as the case may be, in a horizontal distance of so many miles. With regard to isothermal maps, it should be remembered that the isotherms represent temperatures *as they would be if all of the land were reduced to the level of the sea.*

This reduction to sea level is one means of obtaining uniformity of method.

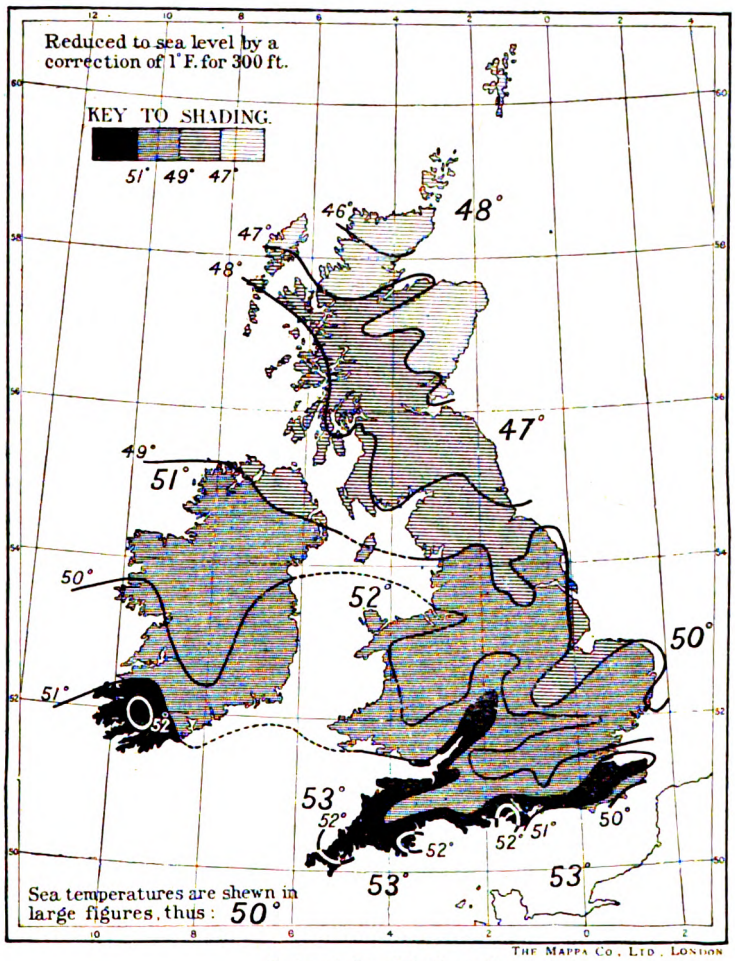
Thermographs. — A continuous record of changes in temperature may be made by means of a self-registering thermometer or *thermograph.*

Thermographs are of different patterns. One kind consists of a metallic spiral composed of strips of two different metals welded together.

These metals expand unequally when the temperature is raised, and contract unequally when the temperature falls. Consequently, a rise in temperature causes the spiral to twist in one direction, while a fall in temperature causes a twist in the opposite direction.

These movements are communicated to a pen attached to one end of the spiral, and alterations in temperature are represented by a line or graph traced by the pen on paper mounted on a cylindrical drum rotated by clockwork. An ascent of the line on the paper represents a corresponding rise in temperature and a descent of the line represents a corresponding fall.

Thermographs should have free access to the atmosphere, yet protection from direct sunshine, rain, etc., in fact, they should be treated in the same manner as other thermometers, hence it is best to place a thermograph in a Stevenson screen. The continuous record kept by a thermograph gives information concerning the daily range of temperature, and it is found that the hottest



By permission of the Controller of H.M. Stationery Office.

BRITISH ISLES: DISTRIBUTION OF MEAN TEMPERATURE.

The average annual temperature gradient is steeper in the S.E. counties of England than in Ireland.

time of the day is generally at 2 p.m., and the coldest part of the night occurs a little before sunrise. The readings of a thermograph should frequently be compared with those of a standard thermometer in order to see that the instrument is working correctly.

Condensation of Clouds. — The temperature of the air is intimately connected with its capacity for holding water vapour. Generally speaking, we may say that the higher the temperature the more water vapour a given volume of air may hold. It does not necessarily follow from this that hot air always contains much water vapour, since heated air over deserts and other regions poor in water has little chance of obtaining moisture. But assuming that the air has a generous supply of water to draw upon, the great oceans for instance, the generalisation concerning temperature and capacity for water vapour holds good. When the air at a certain temperature holds as much water vapour as it can do at that temperature, it is said to be saturated, and if the temperature of the air then falls, water vapour is condensed to water.

An essential condition of condensation is the presence of dust motes in the air. Experiments have shown that without the existence of these minute particles of dust, the change from water vapour to water does not take place, although the air may be cooled very much below the temperature at which dew would form if dust motes were present.

(Refer to the Lesson on Heat Vol. II., p. 68.)

But there are always dust motes in the air except in cases where they have been removed from closed volumes of air for experimental purposes. The number of dust particles in air has actually been estimated. Even in the atmosphere over open country there are hundreds of dust motes in every cubic centimetre of air, whilst every cubic centimetre of air over large towns contains hundreds of thousands. The importance of these minute bodies floating in the atmosphere cannot be over-estimated. They not only affect condensation, but exert an influence on light effects, such as the production of vivid colours at sunsets. Some of the most brilliant sunsets ever seen occurred in the summer of 1883 and were due to the great increase in the number of motes in the atmosphere by the extraordinary volcanic explosion of Krakatoa which hurled millions of minute volcanic particles high into the air.

As a rule the number of dust particles in the air is sufficient to lead to the formation of clouds when cooling takes place sufficiently to produce condensation of water vapour.

Every cloud consists of millions of dust motes, each bearing its drop of water resulting from condensation. If further cooling and consequent condensation takes place the drops of water become too heavy to remain suspended so that rain falls. Although the rain with which we are familiar reaches the ground, it must not be imagined that all rain produced in the atmosphere reaches terra firma. The falling water of some showers taking place high up in the atmosphere may enter a lower strata of air sufficiently warm to re-evaporate the rain, in which case it does not reach the ground.

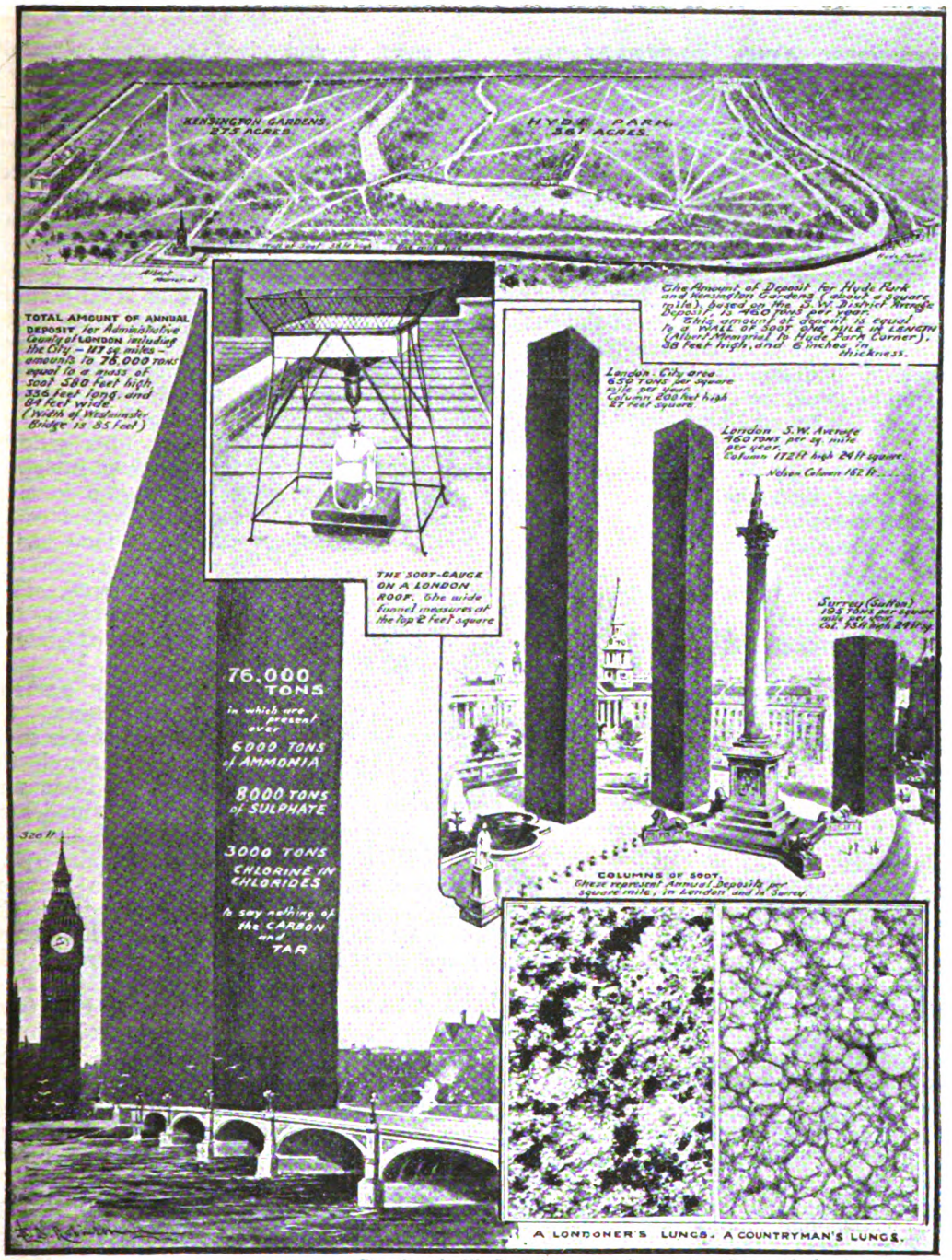
The formation of rain is nearly always associated with the formation of clouds, but it is possible for rain to fall from a clear sky.

When the number of dust motes is relatively small, each particle receives an unusual proportion of condensed water, so that although the number of motes is quite inadequate for the production of clouds, the rain falls because each mote is unable to support its liquid burden. It is worthy of note that in a cloud of considerable vertical thickness the dust particles in the upper portion are not so numerous as in the lower portion; hence those in the higher parts of the cloud carry an undue proportion of water, and become too heavy; consequently they sink through the cloud and merge with other water particles as they fall. This considerably influences the rate at which rain is produced.

Besides forming a stage in the usual production of rain, clouds have other functions. They form a screen which prevents excessive radiation of heat from the earth, and if it were not for this protective curtain of cloud, the earth would lose much more heat than it could afford to lose. Even in the absence of clouds, the dust motes act as a heat screen, but to a much smaller extent; hence it is colder on clear nights than on cloudy ones.

Mists and fogs which are near to the ground are formed in much the same manner as clouds. City fogs contain an exceptionally high proportion of dust motes, a condition that has some bearing upon the fact that a fog usually does not v[illegible] as does a mist formed above the sea or above meadows.

Fog, mist and dew were described in the Lesson on Heat, Vol. II., p. 68. **L. M. P.**



Drawings by W. B. Robinson; and two micro-photographs by A. E. Smith.

LONDON'S PALL.

A pictorial representation of the sootfall which darkens the great city. On the basis of the sootfall in the city area the yearly deposit over the Administrative County of London would reach the enormous figure of 76,050 tons, including over 6,000 tons of ammonia, 8,000 tons of sulphates, and 3,000 tons of chlorine in chlorides, to say nothing of the carbon and tar. On the basis of the smaller sootfall in the South-West metropolitan area, the annual deposit over the London County would average 53,820 tons. The dweller in the suburbs enjoys comparative immunity from this downpour of chemical substances. Our illustration also includes a micro-photographic comparison between the lung of a Londoner and that of a breather of purer country air.

ANATOMY AND PHYSIOLOGY. XIII

A GREAT deal of digestion's action depends on the presence of *ferments*, and ferments are not easy things to understand. The digestive secretions, namely, the gastric juice, the saliva, and the secretion of the pancreas in the small intestine, produce changes in the chemical composition of the food. But they only act when they are warmed up to the temperature of the body, and if they are boiled they lose their power altogether. No one has ever examined a ferment by itself, no one has ever prepared a tube full of ferment and been able to say "this is ferment and nothing else." We only know that the digestive secretions will produce these changes under the proper conditions, and that if the secretions are boiled that power is lost for good and all.

Food can be digested artificially in test tubes and the processes can be studied. If you take meat, and mix gastric juice with it, and keep it at the temperature of the body, the meat will be digested as it would be in the stomach.

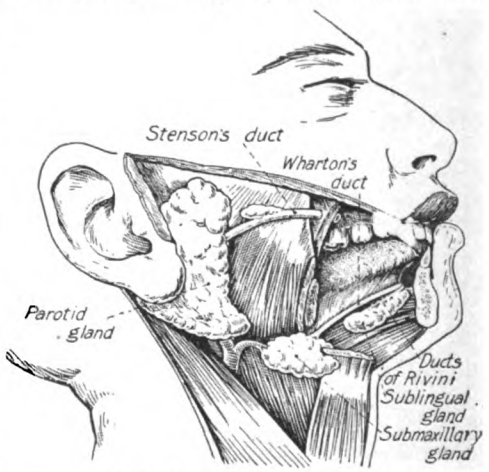
A ferment often used in the household is rennet, for making curds and whey. Rennet is a ferment which clots milk, and if it is put into milk and kept warm, the milk goes solid and squeezes out the whey. If you boil the rennet it will no longer clot milk. The clotting of blood described in Vol. IV., p. 464, also depends on a ferment.

Digestion in the stomach depends on a ferment called *pepsin* in the gastric juice; it acts in the presence of hydrochloric acid, which is also secreted by the stomach. Its only action is on proteids; and here a few words on proteids.

Proteids are very complicated bodies in their chemistry; they contain carbon, hydrogen, oxygen, nitrogen and sulphur. The proteid of meat is an *albumen*, the proteid of bread is called *gluten*, the proteid of milk is called *casein*, from which cheese is made. These proteids all differ from one another, but all have certain properties in common and give the same chemical tests, of which the first is that when dissolved they are precipitated by boiling.

In digestion they are changed, first into *albumose* and then into *peptone;* in each change there is a combination with water. They are not mixed with water, but combined with it as the chlorine is combined with hydrogen in hydrochloric acid. Peptone when it is produced can no longer be precipitated by boiling. Peptone is the form in which proteid is absorbed by the blood vessels.

Only a part of the proteid is changed into peptone in the stomach, a great deal of it is still undigested when the stomach contents (called *chyme* and pronounced kime) pass through the pylorus into the small intestine.



THE SALIVARY GLANDS, **namely, the parotid, sublingual and submaxillary, have ducts which open into the mouth; their secretions are the first agents of digestion.**

The chyme is acid, and the next ferment which the food has to meet is the secretion of the pancreas, called *trypsin*, and this only acts in an alkaline liquid.

The chyme enters the duodenum, the upper part of the small intestine, through the pylorus. A little way down the duodenum the ducts of two important glands open into it, the *common bile duct* from the *liver*, and the duct of the *pancreas*. The secretion of the liver is the bile, and it is alkaline, and contains enough alkali to neutralise the acid chyme and make the contents of the intestine alkaline. When this has happened the trypsin from the pancreas can act. Trypsin is the most important digestive ferment in the body; it acts on all the proximate principles; it acts on undigested proteids, and albumoses, converting them into peptone; it acts on starch and converts it into sugar, and it *emulsifies* fats.

Pour a little oil into a test tube of water and shake it violently. The oil will break up into droplets which are scattered all through the water, but on standing for a minute or two the oil will come to the surface as a layer. But if you use soapy water the drops will be coated with a layer of soap and will not run together. This forms an *emulsion*.

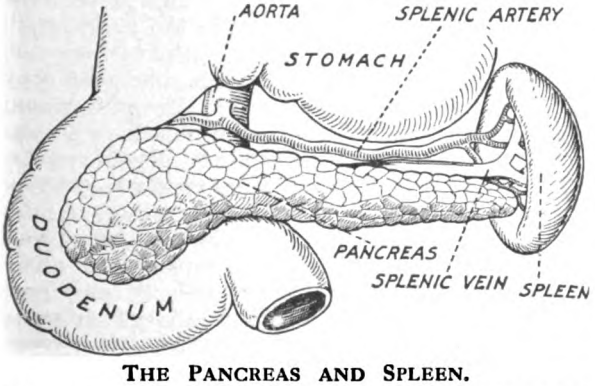
Now fat is, chemically, a combination of

glycerine with what is called a *fatty acid* —an acid containing carbon, hydrogen and oxygen in certain definite proportions. And *soap* is a combination of an alkali, like soda, with a fatty acid. Trypsin has the power of *breaking up* fat into glycerine and fatty acid, and when this has happened the fatty acid combines with the alkali of the bile and forms a soap which coats the remaining drops of fat and so forms an emulsion. The fat of milk is in a very perfect state of emulsion. It is in the form of emulsion that fat is absorbed.

Some of the peptone is absorbed as such, and some of it is broken up into simpler bodies called *leucin* and *tyrosin*. There are many germs present in the intestine, and these act on part of the leucin and tyrosin and break them up into still simpler bodies, called *indole* and *skatole*, and it is these substances which make fæces smell as they do.

The small intestine is studded with glands which secrete a fluid called the *succus entericus* which has a small digestive action on sugars.

The process of chemical digestion is now

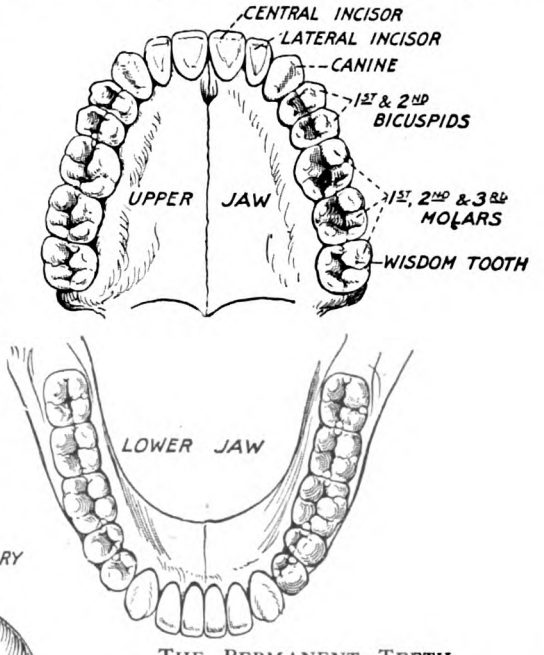


THE PANCREAS AND SPLEEN.

The pancreas is a soft glandular organ in the upper part of the abdomen and is closely connected with the duodenum. The spleen, which is made of lymphoid tissue, is surrounded by the peritoneum; it has no duct, but is freely supplied with blood vessels.

complete, and we have next to consider how the digested food is absorbed. It should be noted that all through digestion, in the mouth, in the stomach and in the intestines, a great deal of water is poured out of the digestive glands into the food material; and when the food is absorbed it is in a very much diluted state.

Absorption of the digested food is not thought to occur in the stomach, but chiefly in the small and large intestines. The mucuous membrane of the small intestine is thrown into folds, called *valvulæ conniventes*, which increase the surface from which absorption can take place. Besides secreting glands, the small intestine is covered with little projections called *villi*, which contain the chief channels of absorption. Every villus consists of a lymphatic



THE PERMANENT TEETH

are thirty-two in number and are quite distinct from the milk or temporary set of the child. This milk set numbers only twenty teeth.

vessel whose end, towards the cavity of the intestine, is closed, round this is a network of capillary blood vessels, and outside this, the epithelium.

Products of proteid and carbohydrate digestion—that is peptone and sugar—are absorbed by the blood vessels and by them carried to the portal vein which leads to the liver. The peptones, leucin and tyrosin taken up by the blood vessels are changed again into proteid on their way through the epithelium covering the villus, for no trace of them can be found in blood taken from the portal vein. Fats, when emulsified, are taken into the central lymphatic vessel of the villus, which is called the *lacteal*, and this lymphatic leads into the chief lymphatic vessel which empties into the superior vena cava.

Absorption occurs also in the large intestine, and all the way down this the contents become more and more dry, till at last they

take on the familiar character of a *motion* or fæces, which are the indigestible parts of the food, together with mucus and substances present in bile, and bacteria or germs.

The blood in the portal vein contains sugar and proteid recently taken up from the intestine. The portal vein enters the liver and breaks up into capillaries around the liver cells. The liver cells take up the sugar and change it into a substance called *glycogen*, which is insoluble, and keep it stored until it is required by the muscles.

The fat which enters the circulation and is not required as fuel, is taken up by connective tissue cells and stored as fat. There does not appear to be any means of storing proteids; a certain amount is required every day to replace loss, but after this the more proteid there is eaten, the more nitrogen is daily lost in the urine.

Muscles require chiefly sugar and fat as their source of fuel. The muscle is able to take up these substances into itself, and when the muscle contracts the carbon combines with oxygen and so supplies the energy necessary for the work to be done.

Anatomy of the Digestive System

The mouth consists of two bony parts: the jaws, the upper one forming the roof and hard palate, and having round its front and sides the upper teeth; the lower jaw or mandible, consists of a horizontal part, which is horseshoe shaped and fitted with teeth which grind against those in the upper jaw; it has also two uprights at the ends of the horseshoe, which are jointed on to the base of the skull and allow of opening and shutting of the mouth and also grinding movements of the teeth.

In the floor of the mouth is the tongue, a muscular structure which is fixed behind. Its point can be moved in all directions, and it has the special sense of taste. Below the tongue are the submaxillary glands, which secrete saliva, and in the cheeks are the parotid glands, which do the same.

At the back of the hard palate is the soft palate, a fleshy curtain which is drawn up and back in swallowing, and closes the pharynx and stops food coming down the nose.

The pharynx is a muscular tube which runs from the base of the skull to the top of the œsophagus. It consists of three chief muscles, the *constrictors* of the pharynx. The upper muscle starts from a bony plate on the base of the skull and a ridge on the inner surface of the lower jaw, and passes backwards to join its fellow of the opposite side in a fibrous cord. The middle constrictor starts from the hyoid bone, spreads out fan-wise, overlaps the upper constrictor, and unites with its fellow of the opposite side in the same way. The lower constrictor starts from the side of the larynx, overlaps the middle one, and joins its fellow behind like the two others.

The œsophagus is a strong muscular tube, which runs through the chest from the pharynx to the diaphragm. It is about nine inches long and lies in the back of the chest slightly to the left of the vertebræ. It consists of muscle arranged in two layers, the outer running lengthwise and the inner in rings; it is lined by mucous membrane.

Duodenum and Intestines

Below the œsophagus, on the far side of the diaphragm, the tube swells out into the stomach, which is a curved bag of the shape shown on p. 333. Its upper border is called the *lesser curvature*, and its lower border the *greater curvature*. The cardiac end is rounded and fits up under the diaphragm. The pylorus varies in position with the amount of food in the stomach.

The stomach is covered with peritoneum, below which is a triple muscular coat consisting of fibres running lengthwise, in rings, and obliquely. Inside the muscle is a submucous coat, in which are blood vessels, and it is lined by mucous membrane. The mucous membrane contains numerous glands, which are of two kinds. Those at the cardiac end of the stomach are simple tubes, lined with square-shaped, or cubical cells, and among them other larger cells which *stain* differently.

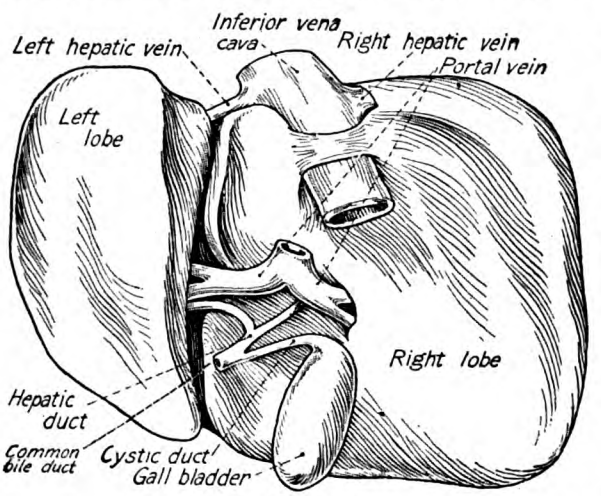
The stomach is kept in place by folds of peritoneum, by which it is slung from the under surface of the liver and diaphragm. From its lower border depends a sort of apron of folds of peritoneum containing much fat, and called the great omentum, which hangs in front of the intestines and probably protects them from cold.

The duodenum is a curved part of the small intestine fixed to the back of the abdomen; it forms a horseshoe shaped curve. One limb runs to the right from the pylorus, then curves down and then bends to the left. The common bile duct and the pancreatic duct open into it about half way down. Below the duodenum the small intestine is freely movable, being only held up by the fold of peritoneum, called the mesentery (*See* p. 336). It is about twenty feet long,

it fills up the middle and left-hand side of the abdomen and ends by opening into the colon near the lower right-hand corner.

The small intestine is covered outside with peritoneum ; inside this is a double layer of muscle, lengthwise and circular, and it is lined by mucous membrane, which is thrown into folds. The inner surface is covered with the villi already described, and with tubular glands ; both are covered with a single layer of *columnar* cells.

The large intestine consists of three chief parts : the ascending, transverse and descending colon. The ascending and descending parts are fixed to the back of the abdomen, because the peritoneum only crosses them and does not go completely round them, but the transverse colon is free to move, being moored in the same way as the small intestine.



THE LIVER

is a glandular organ which secretes the bile that passes into the small intestine and aids digestion. The gall bladder is a conical bag, containing bile, which lies under its surface.

Below the covering of peritoneum there are two layers of muscle, lengthwise and circular, but the lengthwise layer is not complete, and only consists of three flat bands running along the colon. There is a lining of mucous membrane, and it has numerous little pits lined by columnar cells.

Throughout the intestines are many small lymphatic glands. The small intestine does not open into the extreme end of the large intestine, but a little way up it ; the opening is protected by two folds of mucous membrane called the *ileo-cæcal valve*, which allows matter to pass from the small to the large intestine, but not back again. The part of the large intestine before this valve is called the *cæcum* ; it ends in the appendix, which is a little tube, shaped like a worm and ending blindly.

Below the descending colon is a curved loop, called the *sigmoid flexure*, at the brim of the pelvis, which leads into the rectum, which is the last part of the tube, and ends at the anus.

The general shape of the liver has already been described. It is placed in the top right-hand corner of the abdomen and is kept in place by folds of peritoneum and by blood vessels.

Blood enters the liver by the portal vein which comes from the intestines. Blood leaves the liver by the hepatic veins. In the liver the portal vein divides up in such a way as to divide the tissue into areas which appear six-sided in a section of the liver ; along with it run the bile ducts. In the centre of each is another vein, a branch of the hepatic vein. These branches run together and open into the inferior vena cava. Capillaries run from the portal veins to the hepatic veins in these areas, and between the capillaries are the liver cells. The liver also has arteries of its own for its own nourishment. The ducts of the liver collect together to form the right and left hepatic ducts, one for each half; these unite on the underside of the organ to form the hepatic duct. Outside the liver, on its under surface, is the gall bladder, which forms a reservoir for the bile; its duct joins on to the hepatic duct, and together they form the common bile duct, which opens into the duodenum. The bile provides the alkaline liquid required for the secretion of the pancreas to work in, and also is a means of excretion of the materials of used up blood corpuscles.

The pancreas is a long flat gland which lies at the back of the abdomen, across the spine. The curve of the duodenum is folded round one end of it. Its duct opens into the duodenum close to the common bile duct.

The spleen is another organ in the abdomen; it is concerned with the formation of blood corpuscles. It is a flat cake - like organ lying under the left ribs over the left-hand end of the stomach.

D. W. C.-J.

Continued from page 346.

LANGUAGES:

Contributors:—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A. [Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

GERMAN.—XXXI

Prepositions (*continued from page* 342).

Mit refers primarily to association with persons, and hence is used in actions either in co-operation with or in company with others. Thus, er kam mit ſeinem Vater, *he came with* (i.e. in company with) *his father*, ich habe mich mit ihm gezankt, *I have quarrelled with him.* Other uses:

(*a*) To denote instrument: er ſchrieb mit einer Stahlfeder, *he was writing with a steel pen.*

(*b*) The idea is somewhat extended in such phrases as mit der Eiſenbahn reiſen, *to travel by train*, and in the formation of adverbial expressions by means of a following abstract noun; ein Amt mit Würde tragen, *to fill an office with dignity.*

(*c*) Sometimes it merely indicates some kind of relationship: es iſt mit ihm vorbei or aus, *it is all over with him;* ich bin mit meiner Arbeit fertig, *I have finished my work.*

Nach is used to indicate motion to a place.

(*a*) Of place: nach Hauſe gehen, *to go home;* nach London reiſen, *to travel to London;* nach dem Fluß hin wird das Land fruchtbarer, *the land grows more fertile in the direction of the river;* nach der Stadt zu, *towards the town.*

(*b*) It is used to indicate the aim of an effort: ſie ſchlugen nach mir, *they struck at me;* ich ſehne mich nach den Bergen, *I long for the mountains;* er ſchickte nach dem Arzt, *he sent for the doctor.*

(*c*) Of time or order: nach drei Stunden, *after three hours;* nach Tiſch, *after dinner* (table); einer nach dem andern, *one after the other.*

(*d*) In the sense of according to: nach Schiller, *according to Schiller;* nach meiner Anordnung, *according to my orders;* nach Belieben, *as you please;* es ſchmeckt nach Eſſig, *it tastes of vinegar;* ich kenne ſie dem Namen nach, *I know her by name.*

Von, *from*, was originally used of motion from a place; it is the opposite of nach and zu.

(*a*) Of place: ich komme vom Gebirge her, *I come from the mountains;* er fiel vom Stuhle, *he fell from the chair;* es flog von Blume zu Blume, *it flew from flower to flower.*

(*b*) In simple metaphors: er iſt von Sinnen, *he is out of his senses;* von einer Sache überzeugt ſein, *to be convinced of a thing;* er grüßt von ganzem Herzen, *he greets* (you) *with all his heart.*

(*c*) It is regularly used to denote the agent after passive verbs: Abel wurde von ſeinem Bruder ermordet, *Abel was murdered by his brother;* er wurde vom Blitz getroffen, *he was struck by lightning.* It is also used with the active infinitive used in a passive sense with laſſen as a causative auxiliary: er ließ die Ringe von einem Künſtler machen, *he had the rings made by an artist;* ein Drama von Leſſing, *a drama* (written) *by Lessing.*

(*d*) To denote the object of thought or conversation: er ſpricht von dem Krieg, *he is talking of the war.*

(*e*) In the sense of in respect of: klein von Geſtalt, *small in stature.*

(*f*) It is prefixed to names as a title of nobility like the French *de:* Prinz von Bülow, Herr von Müller.

Von is often used in conjunction with words like auf, an, etc.: von Kindheit auf, *from childhood upwards;* von heute an, *from this day forward.*

Zu means *to* or *at*, and has many idiomatic uses.

(*a*) Of place; it denotes *to* before persons, just as nach denotes *to* before places: er ging zu ſeinem Onkel, *he went to his uncle.* However, where the place is not specified, but is only vaguely indicated, zu is often used: zu Grunde gehen, *to be ruined;* zu Kreuze kriechen, *to humble oneself* (to creep to the cross); zu Bette gehen, *to go to bed.*

It denotes *at, on, by,* or *in:* der Dom zu Köln am Rhein, *the cathedral at* (or in) *Cologne on the Rhine;* akin to this is its use in connection with the names of inns: der Gaſthof zum Weißen Hirſch, *the inn of the White Stag* (at the sign of the White Stag). In a good many phrases: zu Land, *by land;* zur See, *by* (or at) *sea;* zu Hauſe, *at home;* zu Pferd, *on horseback;* zu Fuß, *on foot;* zur Linken, *on the left;* zur Seite, *on one side, aside.*

(*b*) Of time; to indicate point of time: zum zweiten Mal, *for the second time;* zur

rechten Zeit, *at the right moment, in time;* zu Zeiten, *at times;* zu Weihnachten, *at Christmas.* To denote *up till*, especially in conjunction with bis; bis zum heutigen Tage, *to this very day.*

(*c*) In metaphorical expressions: zur Rede ſtellen, *to call to account;* zu Geſichte bekommen, *to get sight of;* zur Ehre gereichen, *to redound to* (one's) *honour;* zu Worte kommen, *to speak* or *get speech of;* and with the idea of direction: zu einem ſprechen, *to speak to one.*

(*d*) When anything is thought of as being brought in connection with another thing: der Schlüſſel zu meinem Pult, *the key to my desk;* Waſſer zu Wein gießen, *to pour water into wine.*

(*e*) To indicate the purpose or result of a thing: dieſes Wetter iſt angenehm zum Reiſen, *this weather is pleasant for travelling;* Fleiſch zum Eſſen kaufen, *to buy meat for dinner;* einem etwas zu Liebe tun, *to do a thing for the love of someone;* einem zu Dienſten ſtehen, *to be at someone's service.*

(*f*) To indicate the price of a thing: ein Kleid zu hundert Mark, *a dress for a hundred marks.*

(*g*) With numerals: zu Tauſenden, *by thousands.*

(*h*) To indicate extent (with or without bis): einen (bis) zur Raſerei lieben, *to love someone to madness;* das iſt zum verrückt werden, *that is enough to drive one mad;* ſein Zuſtand war zum Erbarmen, *his condition was pitiable.*

Prepositions governing the Accusative:—Durch means *through;* it is used in the following ways:

(*a*) Of place it means through from one side to the other: er drängte ſich durch die Menſchenmenge, *he pushed his way through the crowd of people;* ich ging durch die Stadt, *I went through the town.*

(*b*) Metaphorically, it comes to mean all round or all over: er möchte dieſe Ideen durch die ganze Welt verbreiten, *he would like to spread these ideas over the whole world.*

(*c*) Of time it is used to denote duration: die ganze Nacht durch, *the whole night through.*

(*d*) It denotes the instrument: ich habe es durch eigne Kraft ſo weit gebracht, *I have succeeded through my own exertions;* er hat ſich durch ihre Schweſter erkundigen laſſen, *he had inquiries made through her sister.*

Für, though it originally referred to places, is now almost entirely used in derived senses and practically corresponds to English *for.*

(*a*) Meaning instead of: für einen handeln, *to act for* (instead of) *someone;* and derived from this meaning it is used for price: ein Buch für drei Mark, *a book for three marks.*

(*b*) In a sense almost equivalent to *as*: ich halte ihn für einen Narren, *I consider* (hold him for) *a fool;* er gibt ſich für einen Arzt aus, *he pretends to be* (gives himself out for) *a doctor.*

(*c*) In the sense of on behalf of: ich ſpreche für ihn, *I speak on his behalf.*

(*d*) In one or two other idiomatic senses: Schritt für Schritt, *step by step;* für ſeine Verhältniſſe, *considering his circumstances;* für's erſte, *for the time being.*

VOCABULARY

Rath, s.m.2, *advice.*
völlig, *completely.*
möglich, *possible.*
dulden, w., *to suffer.*
indem, *in that.*
begünſtigen, w., *to favour.*
nacheifern, w., *to strive zealously for* (gov. dat.), *emulate.*
frei, *free.*
um die Wette, w.f., *in emulation.*
herzlich, *hearty, cordial.*
Wohlthun, s.n.1, *benevolence, charity.*
Ergebenheit, w.f., *submission, devotion.*
laden, s., *to summon.*
beſcheiden, *modest.*
ergreifen, s., *to seize.*
Staub, s.m.2, *dust.*
zu'ſtürzen auf, w., *to rush towards.*
fahren laſſen, *to let go,*
um ſein, *to be over, past.*
Spruch, s.m.2, *judgment, verdict.*
ſicher, *assuredly.*
Tyrannei, w.f., *tyranny.*
gewiß, *certain.*
drücken, w., *to oppress, vex.*
eifern, w., *to act with zeal, to vie.*
unbeſtochen, *uncorrupted, pure.*
Vorurtheil, s.n.2, *prejudice.*
ſtreben, w., *to endeavour.*
Sanftmuth, f., *meekness, gentleness.*
Verträglichkeit, w.f., *peaceableness.*
innig, *fervent, devout.*
zu Hülfe kommen, *to come to the aid of.*
äußern, w., *to become manifest.*
wiederum, *once again.*

Exercise 69 (*continued from* 67)

Nathan.—

Und alſo, fuhr der Richter fort, wenn ihr
Nicht meinen Rath, ſtatt meines Spruches, wollt:
Geht nur[1]! — Mein Rath iſt aber der[2]: ihr nehmt[3]
Die Sache völlig wie ſie liegt. Hat[4] von
Euch jeder ſeinen Ring von ſeinem Vater:
So glaube[5] jeder ſicher ſeinen Ring
Den echten[6]. — Möglich[7], daß der Vater nun
Die Tyrannei des einen Rings nicht länger
In ſeinem Hauſe dulden wollen[8]! — Und gewiß[7],
Daß er euch alle drei geliebt, und gleich
Geliebt[8]: indem er zwei nicht drücken[8] mögen,
Um einen zu begünſtigen. — Wohlan!
Es eifre[9] jeder ſeiner unbeſtochnen,
Von Vorurtheilen freien Liebe nach!
Es ſtrebe[10] von euch jeder um die Wette,
Die Kraft des Steins in ſeinem Ring an Tag[11]
Zu legen! Komme[12] dieſer Kraft[13] mit Sanftmuth,
Mit herzlicher Verträglichkeit, mit Wohlthun,
Mit innigſter Ergebenheit in Gott,
Zu Hülf'! Und wenn ſich dann der Steine[14] Kräfte
Bei euern Kindes-Kindeskindern[15] äußern:
So lad' ich über[16] tauſend tauſend Jahre
Sie wiederum vor dieſen Stuhl. Da wird
Ein weiſ'rer[17] Mann auf dieſem Stuhle ſitzen,
Als ich; und ſprechen. Geht! — So ſagte der
Beſcheid'ne[18] Richter.

G. E. Leſſing.

NOTES :—

(1) nur, this had better be omitted in translating, or the phrase may be rendered by *you had better go*. (2) der—demonstrative equivalent to dieſer. (3) nehmt—this Indicative is almost equivalent to an Imperative, you should accept the matter exactly as it is (lies). (4) hat—the inverted order to express a condition. (5) glaube—this and the following Present Conjunctives are really Imperatives, *let each one believe*. (6) den echten—note the double accusative after glauben. (7) möglich—this stands for es iſt möglich and below gewiß stands for es iſt gewiß. (8) wollen—the auxiliary hat is understood with this; in prose it would precede dulden. Similarly, the auxiliary hat is understood after geliebt each time, and before drücken. (9) eifre, *see* (5). (10) ſtrebe, *see* (5). (11) an Tag zu legen, *to demonstrate, prove*. (12) komme, *see* (5). (13) Kraft—this is dative governed by zu Hülfe kommen. (14) der Steine, genitive dependent on Kräfte. (15) Kindes-Kindeskinder — literally, children's children's children, i.e. remote descendants. (16) über tauſend tauſend Jahre, *in* (or after) *a thousand thousand years*. (17) weiſrer, abbreviated form for weiſerer. (18) beſcheidne for beſcheidene.

VOCABULARY

brave, brav.
gallant, tapfer.
to offer homage, huldigen, w. gov. dat.
sick, krank.
to fight for, ſich ſtreiten (s.) um.
let, erlauben, w. gov. dat.
pronounce, ausſprechen, s. sep.
favourite, liebſte.
anger, Zorn, s.m.
schoolmaster, Schulmeiſter, s.m.1.
tender, zart.
grow, werden, s.
to care for, ſich kümmern (w.) um.
kind, gut, lieb.
hereby, hiermit.
give thanks, danken, w. gov. dat.
pleasant, angenehm.
lady, Dame, w.f.
volume, Band, s.n.2.
far, weit.
reader, Leſer, s.m.1.
eulogium, s.n., Lob.
author, Schriftſteller, s. m.1.
reverberation, Prügel, s. m.1.
remonstrance, Verweis, s.m.2.
pleading, Bitte, w.f.
scapegrace, Taugenichts s.m.1.

Exercise 70 (*continued from* 68)

O Dumas! O thou brave, kind, gallant old Alexandre! I hereby offer thee homage, and give thee thanks for many pleasant hours. I have read thee (being[1] sick in bed) for[2] thirteen hours of a happy day, and had[3] the ladies of the house fighting for the volumes.[4] Be assured[5] that lazy boy was reading Dumas (or I will go so far as[6] to let the reader here pronounce[7] the eulogium, or insert[8] the name of his favourite author); and as for the anger[9], or it may[10] be the reverberations of his schoolmaster, or the remonstrances[11] of his father, or the tender pleadings of his mother that he should not let the supper grow cold—I don't believe the scapegrace cared one fig.[12]

W. M. Thackeray.

NOTES :—

(1) *Being*, say *when* (als) *I lay in bed*. (2) *For*, say *during* (während). (3) *And had*, etc., say *whilst* (derweilen) *the ladies . . . fought*. (4) *Volume* (Band); the student must not confuse this with the neuter Band, which has the plural Bänder, when it means *ribbon*, and the plural Bande when it means *bond*. (5) *Be assured*, say *assuredly* (ſicherlich). (6) Omit *as*. (7) *Pronounce*—it is usual to say das Lob ſingen (sing). (8) *Insert*, say *name* (nennen); place the words *of his favourite author* after *eulogium*, and say *his* (deſſen) instead of *the name*. (9) *As . . . anger*, was den Zorn betrifft. (10) *It may be*, auch. (11) *Remonstrance*—use this in the singular. (12) *One fig*, say *in the least* (im geringſten) *about them* (darum).

Key to Exercise 67

Nathan.—Let us return to our rings. As I said (as was said), the sons went to law; and each swore to the judge that he had (to have) received the ring directly from his father's hand, as was true, after having long ago been promised by him (after he had long already had the promise from him) some day to enjoy the privilege of the ring. As was no less true. Each one asseverated that the father could not have played him false; and that sooner than to allow this suspicion to fall on him, on such a dear father (and that before he would allow this to be suspected of him, of such a dear father), sooner than that he must accuse his brothers of cheating, however gladly he would otherwise be ready to believe only the best of them; and he would know how to unmask (find out) the traitors—would take his revenge.

Saladin.—And what about the judge? I am anxious to hear what you make the judge say. Speak.

Nathan.—The judge said: Well, if you do not shortly (soon) produce your father, then I will dismiss you from my tribunal. Do you think that I am here to solve riddles? Or are you waiting for the real ring to speak (open its mouth)? But stay! I hear that the true ring possesses the magic power to make the wearer beloved, make him find favour in the eyes of God and men. That must decide! For the false rings will surely not be able to do this! Now, whom do two of you love most? Come, tell me! You are silent? Do the rings only act inwardly, and not outwardly? Does each one only love himself the best? O, then, you are all three deceived deceivers! Your rings are all three not real. The real ring presumably was lost. To hide the loss and to make it good your father had three made instead of one.

Saladin.—Splendid! Splendid!

Key to Exercise 68

Was war es das den jungen Studenten ſo bezauberte, als er auf dem Flußufer ſtand? Nicht das Pons Aſinorum. Welches Buch entzückte ihn ſo und machte ihn gegen die ganze übrige Welt blind?, ſo daß er ſich nichts daraus machte die Apfelfrau mit ihrem Obſt zu ſehen oder (was die Söhne Evas noch mehr anzieht) die hübſchen Mädchen mit den Apfelwangen, die um den Springbrunnen lachten und ſchwatzten! Was war das Buch? Glaubt ihr wohl daß es Livius war, oder die griechiſche Grammatik? Nein; es war ein Roman welchen du laſeſt, du träger, nicht ſehr reiner, vernünftiger Taugenichts! Es war d'Artagnan der General Monk in eine Kiſte einſchloß, oder dem es beinahe gelang Karls des Erſten Kopf auf den Schultern zu erhalten. Es war der Gefangene von dem Chateau d'If der ſich fünfzig Fuß unter Waſſer aus dem Sack herausſchnitt (ich nenne die Romane welche ich ſelbſt am liebſten habe — Romane ohne Liebelei oder Geſpräche, oder irgend welchen Unſinn der Art, die aber von Gefechten, Entwiſchen, Raub und Befreiungen die Menge handeln) — der ſich aus dem Sack herausſchnitt, und nach der Inſel von Monte Criſto ſchwamm.

M. A. L.

GREEK.—IX

VERBS IN ω (*continued*)

PASSIVE AND MIDDLE VOICES, λύομαι, *I am loosed* (pass.), *I loose for myself* (mid.)

PRESENT (stem λυ-)

		Indicative.	*Subjunctive.*	*Optative.*	*Imperative.*	*Infinitive.*	*Participle.*
Sing.	1.	λύομαι, *I am loosed*, or *I loose for myself*, etc.	λύωμαι, *I may loose myself*, etc.	λυοίμην, *I might loose myself*, etc.		λύεσθαι, *to be loosed* or *to loose for oneself*	λυόμενος, λυομένη, λυόμενον, *loosing oneself*
	2.	λύῃ or λύει	λύῃ	λύοιο	λύου, *loose thou thyself*, etc.		
	3.	λύεται	λύηται	λύοιτο	λυέσθω		
Dual	2.	λύεσθον	λύησθον	λύοισθον	λύεσθον		
	3.	λύεσθον	λύησθον	λυοίσθην	λυέσθων		
Plur.	1.	λυόμεθα	λυώμεθα	λυοίμεθα			
	2.	λύεσθε	λύησθε	λύοισθε	λύεσθε		
	3.	λύονται	λύωνται	λύοιντο	λυέσθωσαν or -έσθων		

IMPERFECT

Sing.	1.	ἐλυόμην, *I was loosing myself*, etc.
	2.	ἐλύου
	3.	ἐλύετο
Dual	2.	ἐλύεσθον
	3.	ἐλυέσθην
Plur.	1.	ἐλυόμεθα
	2.	ἐλύεσθε
	3.	ἐλύοντο

PERFECT (tense-stem λελυ-)

		Indicative.	*Subjunctive.*	*Optative.*	*Imperative.*	*Infinitive.*	*Participle.*
Sing.	1.	λέλυμαι, *I have been loosed*, etc.	λελυμένος ὦ, *I may have been loosed*, etc.	λελυμένος εἴην, *I might have been loosed*, etc.		λελύσθαι, *to be loosed*	λελυμένος, -η, -ον, *having been loosed*
	2.	λέλυσαι	λελυμένος ᾖς	λελυμένος εἴης	λέλυσο, *be thou loosed*, etc.		
	3.	λέλυται	λελυμένος ᾖ	λελυμένος εἴη	λελύσθω		
Dual	2.	λέλυσθον	λελυμένω ἦτον	λελυμένω εἶτον or εἴητον	λέλυσθον		
	3.	λέλυσθον	λελυμένω ἦτον	λελυμένω εἶτην or εἰήτην	λελύσθων		
Plur.	1.	λελύμεθα	λελυμένοι ὦμεν	λελυμένοι εἶμεν or εἴημεν			
	2.	λέλυσθε	λελυμένοι ἦτε	λελυμένοι εἶτε or εἴητε	λέλυσθε		
	3.	λέλυνται	λελυμένοι ὦσι(ν)	λελυμένοι εἶεν or εἴησαν	λελύσθωσαν or -σθων		

PLUPERFECT

Sing.	1.	ἐλελύμην, *I had been loosed*, etc.
	2.	ἐλέλυσο
	3.	ἐλέλυτο
Dual	2.	ἐλέλυσθον
	3.	ἐλελύσθην
Plur.	1.	ἐλελύμεθα
	2.	ἐλέλυσθε
	3.	ἐλέλυντο

FUTURE-PERFECT (tense-stem λελῡσ-)

Sing.	1.	λελύσομαι, *I shall be free* or *have been liberated*, etc.	λελυσοίμην, *I would be free*, etc.	λελύσεσθαι, *to be about to be free*	λελυσόμενος, -η, -ον, *about to be set free*
	2.	λελύσῃ or -ει	λελύσοιο		
	3.	λελύσεται	λελύσοιτο		
Dual	2.	λελύσεσθον	λελύσοισθον		
	3.	λελύσεσθον	λελυσοίσθην		
Plur.	1.	λελυσόμεθα	λελυσοίμεθα		
	2.	λελύσεσθε	λελύσοισθε		
	3.	λελύσονται	λελύσοιντο		

MIDDLE VOICE

FUTURE

Sing.	1.	λύσομαι, *I shall free for myself*, etc.	λυσοίμην, *I would free for myself*, etc	λύσεσθαι, *to be about to free for oneself*	λυσόμενος, λυσομένη, λυσόμενον, *about to free for oneself*
	2.	λύσῃ or λύσει	λύσοιο		
	3.	λύσεται	λύσοιτο		
Dual	2.	λύσεσθον	λύσοισθον		
	3.	λύσεσθον	λυσοίσθην		
Plur.	1.	λυσόμεθα	λυσοίμεθα		
	2.	λύσεσθε	λύσοισθε		
	3.	λύσονται	λύσοιντο		

FIRST AORIST (tense-stem λυσ-)

		Indicative.	*Subjunctive.*	*Optative.*	*Imperative.*	*Infinitive.*	*Participle.*
Sing.	1.	ἐλυσάμην, *I loosed myself*,	λύσωμαι, *I may loose myself*, etc.	λυσαίμην, *I might loose myself*, etc.		λύσασθαι, *to have loosed oneself*	λυσάμενος, λυσαμένη, λυσάμενον, *having loosed for oneself*
	2.	ἐλύσω	λύσῃ	λύσαιο	λῦσαι, *loose thyself*, etc.		
	3.	ἐλύσατο	λύσηται	λύσαιτο	λυσάσθω		
Dual	2.	ἐλύσασθον	λύσησθον	λύσαισθον	λύσασθον		
	3.	ἐλυσάσθην	λύσησθον	λυσαίσθην	λυσάσθων		
Plur.	1.	ἐλυσάμεθα	λυσώμεθα	λυσαίμεθα			
	2.	ἐλύσασθε	λύσησθε	λύσαισθε	λύσασθε		
	3.	ἐλύσαντο	λύσωνται	λύσαιντο	λυσάσθωσαν or -άσθων		

SECOND AORIST (tense-stem λιπ-)

Sing.	1.	ἐλιπόμην, *I remained behind* or *I left for myself*, etc.	λίπομαι, *I may have remained behind*, etc.	λιποίμην, *I might have remained behind*, etc.		λιπέσθαι, *to have remained behind*	λιπόμενος, λιπομένη, λιπόμενον, *having remained behind*
	2.	ἔλιπες	λίπῃ	λίποιο	λιποῦ, *remain thou behind*		
	3.	ἐλίπετο	λίπηται	λίποιτο	λιπέσθω		
Dual	2.	ἐλίπεσθον	λίπησθον	λίποισθον	λίπεσθον		
	3.	ἐλιπέσθην	λίπησθον	λιποίσθην	λιπέσθων		
Plur.	1.	ἐλιπόμεθα	λιπώμεθα	λιποίμεθα			
	2.	ἐλίπεσθε	λίπησθε	λίποισθε	λίπεσθε		
	3.	ἐλίποντο	λίπωνται	λίποιντο	λιπέσθωσαν or -έσθων		

PASSIVE VOICE

The present, imperfect, perfect, pluperfect, and future-perfect tenses are the same in the passive as in the middle voice.

FUTURE (tense-stem λυθησ-)

Sing.	1.	λυθήσομαι, *I shall be loosed* or *set free*, etc.	λυθησοίμην, *I would be set free*, etc.	λυθήσεσθαι, *to be about to be set free*	λυθησόμενος, λυθησομένη, λυθησόμενον, *about to be set free*
	2.	λυθήσῃ or -ει	λυθήσοιο		
	3.	λυθήσεται	λυθήσοιτο		
Dual	2.	λυθήσεσθον	λυθήσοισθον		
	3.	λυθήσεσθον	λυθησοίσθην		
Plur.	1.	λυθησόμεθα	λυθησοίμεθα		
	2.	λυθήσεσθε	λυθήσοισθε		
	3.	λυθήσονται	λυθήσοιντο		

FIRST AORIST (tense-stem λυθ-)

		Indicative.	*Subjunctive.*	*Optative.*	*Imperative.*	*Infinitive.*	*Participle.*
Sing.	1.	ἐλύθην, *I was loosed*, etc.	λυθῶ, *I may be loosed*, etc.	λυθείην, *I might be loosed*, etc.		λυθῆναι, *to be loosed*	λυθείς, λυθεῖσα, λυθέν, *loosed* or *having been loosed*
	2.	ἐλύθης	λυθῇς	λυθείης	λύθητι, *be thou loosed*, etc.		
	3.	ἐλύθη	λυθῇ	λυθείη	λυθήτω		
Dual	2.	ἐλύθητον	λυθῆτον	λυθ- (είητον) -εῖτον	λύθητον		
	3.	ἐλυθήτην	λυθῆτον	λυθ- (ειήτην) -είτην	λυθήτων		
Plur.	1.	ἐλύθημεν	λυθῶμεν	λυθ- (είημεν) -εῖμεν			
	2.	ἐλύθητε	λυθῆτε	λυθ- (είητε) -εῖτε	λύθητε		
	3.	ἐλύθησαν	λυθῶσι	λυθ- (είησαν) -εῖεν	λυθήτωσαν or -έντων		

SECOND AORIST (tense-stem φαν-)

Sing.	1.	ἐφάνην, *I appeared*, etc,	φανῶ, *I may appear*, etc.	φανείην, *I might appear*, etc.		φανῆναι, *to appear*	φανείς, φανεῖσα, φανέν, *having appeared.*
	2.	ἐφάνης	φανῇς	φανείης	φάνηθι, *appear thou*		
	3.	ἐφάνη	φανῇ	φανείη	φανήτω		
Dual	2.	ἐφάνητον	φανῆτον	φανεῖτον or -είητον	φάνητον		
	3.	ἐφανήτην	φανῆτον	φανείτην -ειήτην	φανήτων		
Plur.	1.	ἐφάνημεν	φανῶμεν	φανεῖμεν or -είημεν			
	2.	ἐφάνητε	φανῆτε	φανεῖτε or -είητε	φάνητε		
	3.	ἐφάνησαν	φανῶσι(ν)	φανεῖεν or -είησαν	φανήτωσαν -έντων		

SECOND FUTURE-PASSIVE (tense-stem φανησ-)

Sing.	1.	φανήσομαι, *I shall appear* or *be shown*	φανησοίμην, *I would appear* or *be shown*	φανήσεσθαι, *to be about to appear* or *be shown*	φανησόμενος, φανησομένη, φανησόμενον, *about to appear* or *be shown.*
	2.	φανήσῃ or -ει	φανήσοιο		
	3.	φανήσεται	φανήσοιτο		
Dual	2.	φανήσεσθον	φανήσοισθον		
	3.	φανήσεσθον	φανησοίσθην		
Plur.	1.	φανησόμεθα	φανησοίμεθα		
	2.	φανήσεσθε	φανήσοισθε		
	3.	φανήσονται	φανήσοιντο		

The tenses of λείπω, *I leave*, and φαινω, *I appear*, in the middle and passive voices, that are not given above are conjugated like the corresponding tenses of λύω, with the exception of the future φανοῦμαι of φαίνω, which is given below, and the perfects λέλειμμαι and πέφασμαι, and the pluperfects ἐλελείμμην and ἐπεφάσμην, which follow the normal conjugation of verbs with consonant stems to be given later.

MIDDLE VOICE, FUTURE, φανοῦμαι (tense-stem φανε-)

Sing.	1.	(φανέομαι) φανοῦμαι, *I shall appear* or *be shown*, etc.	(φανέοιμην) φανοίμην, *I would appear*, or *be shown.*	(φανέεσθαι) φανεῖσθαι, *to be about to appear* or *be shown*	(φανεόμενος) φανούμενος- φανουμένη, φανού, μενον, *about to appear or be shown*
	2.	(φανέῃ, φανέει) φανῇ or -εῖ	(φανέοιο) φανοῖο		
	3.	(φανέεται) φανεῖται	(φανέοιτο) φανοῖτο		
Dual	2.	(φανέεσθον) φανεῖσθον	(φανέοισθον) φανοῖσθον		
	3.	(φανέεσθον) φανεῖσθον	(φανεοίσθην) φανοίσθην		
Plur.	1.	(φανεόμεθα) φανούμεθα	(φανεοίμεθα) φανοίμεθα		
	2.	(φανέεσθε) φανεῖσθε	(φανέοισθε) φανοῖσθε		
	3.	(φανέονται) φανοῦνται	(φανέοιντο) φανοῖντο		

Exercise 9

(*a*) Translate into English :—

1. Λυθησόμεθα. 2. Λελυσόμεθα. 3. Λύθητι. 4. Φῆναι 5. Ἐφηνάμεθα. 6. Ἐφάνημεν. 7. Φανούμεθα or φανησόμεθα. 8. Λελύσεται. 9. Ἐλυθημεν. 10. Λῡθησόμενος. 11. Λυθείημεν. 12. Λυώμαι. 13. Ἐλιπομην. 14. Λύσασθε. 15. Λιποίμην. 16. Λίπωμαι. 17. Ἐλυσω. 18. Ἐλυεσθε. 19. ἐλελυμην. 20. λυθησομαι.

(*b*) Translate into Greek :—

1. I might loose myself. 2. I may loose myself. 3. I was loosing myself. 4. I loosed myself. 5. They are loosing themselves. 6. They were loosing themselves.

Key to Exercise 8

(*a*) 1. The opinion of the ancients is the best. 2. Time is the best counsellor. 3. The truest is the best. 4. Grief is a very great evil. 5. I had loosed or set free. 6. Ye two would loose.

(*b*) 1. Λέλυκα. 2. Λύσω. 3. Λύσοις. 4. Ἔλυον. 5. Ἐλυέτην. 6. Λῦσων.

E. A. B.

ITALIAN.—XI

The Verb — Past Definite. — This tense refers to an action as having happened at a time definitely fixed (whether expressed or implied) and completely terminated, also without being related to the present, whereas the imperfect, as explained on page 157, expresses the continuity or repetition of a past action, without reference to its termination. Therefore the imperfect may generally be expressed by such phrases as " I, etc., was buying, was in the habit of buying, used to buy, was buying when you spoke," the word " spoke " being in the past definite, as it refers to an action which took place at an absolutely fixed moment (now elapsed). In other words, the Past Definite carries events forward to the next stage, whilst the Imperfect keeps them at the same point, without passing on to further action.

The Perfect Tense " ho comprato, etc.," may easily be confused with the Past Definite by the beginner, but, whereas the Past Definite has no relation to the present time, the Perfect is connected with it. The examples given below should set at rest any doubt the student may still have.

First or " A " Conjugn.	*Second or " E " Conjugn.*	*Third or " I " Conjugn.*
Sing.	*Sing.*	*Sing.*
1. -ái	-éi	-ii
2. -asti	esti	-isti
3. -ò	-è	-ì
Plur.	*Plur.*	*Plur.*
1. -ammo	-emmo	-immo
2. -aste	-este	-iste
3. -árono	-érono	-írono
Sing.	*Sing.*	*Sing.*
1. comprái	vendéi	partii
2. comprasti	vendesti	partisti
3. comprò	vendè	partì
Plur.	*Plur.*	*Plur.*
1. comprammo	vendemmo	partimmo
2. compraste	vendeste	partiste
3. comprárono	vendérono	partírono

Verbs in **-ere** may also, in the 1st and 3rd persons singular and 3rd person plural, end in **-etti**, **-ette**, **-éttero**, and in some verbs these terminations are preferable, but seeing that for regular verbs the endings shown in the above table are always correct, the student had better use these when dealing with regular verbs in **-ere**.

The Past Definite of **Avere** and **Éssere** is irregular :—

Avere.	*Essere.*
Sing.	*Sing.*
1. ebbi, *I had.*	fúi, *I was.*
2. avesti, *thou hadst.*	fosti, *thou wast.*
3. ebbe, *he had.*	fu, *he was.*
Plur.	*Plur.*
1. avemmo, *we had.*	fummo, *we were.*
2. aveste, *you had.*	foste, *you were.*
3. ébbero, *they had.*	fúrono, *they were.*

Examples :—

Noi scrivevamo ai debitori mentre voi parlavate col cliente,	*We were writing to the debtors whilst you were speaking with the customer.*
Il mese scorso, mentre voi eravate qui, andammo a Firenze ed a Venezia,	*Last month, whilst you were here, we went to Florence and to Venice.*
Ho comprato dei Francobolli per queste léttere, *le quali* invierò col primo corriere,	*I have bought some stamps for these letters, which I shall send by the first post.*

NOTE.—The relative pronouns: **il quale, la quale, i quali, le quali,** *who, which, that,* distinguish the antecedent more clearly than **che.** It should be remembered that in Italian the relative pronoun can never be omitted as in English.

Il presidente ed il segretario mi spiegárono gli statuti della compagnía,	*The president and the secretary explained to me the statutes of the company.*
Abbiamo spedito la merce che ci ordinaste,	*We have forwarded the goods* (which) *you ordered from us.*
Fu un vero piacere per me ésservi stato útile,	*It was a real pleasure for me to have been useful to you.*
Andárono ier l'altro a Londra,	*They went to London the day before yesterday.*
Leggevamo quando voi entraste nella nostra cámera,	*We were reading when you entered our room.*
A quell'época (= quella época) i Veneziani érano un gran pópolo,	*At that time the Venetians were a great people.*
L'anno passato ébbero molte traversíe (sventure),	*Last year they had many misfortunes.*
Le traversíe che lúi ebbe in quell'anno lo attristárono moltíssimo,	*The crosses* (misfortunes, calamities) *which he had in that year saddened him very much.*

NOTE.—The disjunctive pronouns **lúi,** etc., of the 3rd person are sometimes used instead of the nominative pronouns **egli,** etc., for emphasis.

L'hanno fatto **loro,**	*They have done it.*
Si occupárono senza indugio della compra (dell'acquisto),	*They occupied themselves without delay with the purchase.*
Assicurái l'invío per l'importo di cinquemila lire italiane,	*I insured the shipment* (parcel, sending) *for the amount of* 5,000 L.It.

(An Italian lira—Pl. lire—is about the value of a franc.)

Allora si ricordò della qualità che avevamo sempre ricevuta,	*Then he remembered the quality we had always received.*
Vi (ci) andò ieri per far delle riscossioni (per operar incassi),	*He went there yesterday to collect some money* (to operate encashment).

NOTE.—The final **e** of the Infinitive is often omitted.

Esaminammo i di lúi (*di lei*) campioni,	*We examined his* (her) *patterns.*

NOTE.—**il (la, i, le) di lúi, di lei,** frequently take the place of **il súo, la súa, i suói, le súe,** since the latter may be taken for his, her (hers), your, yours (polite form), its, ones. The 3rd person feminine singular and plural of pronouns and verbs is sometimes used for greater politeness, with or without a title, as: Ella (lei ; Vostra Signoría, *Your Lordship* or *Ladyship* ; Vostra Eccellenza ; or their plural forms: loro ; élleno ; le Vostre Signoríe *or* lor Signori), as: Come va Ella ? *How are you ?*

C'incaricò di far loro i di lúi saluti,	*He asked us to give them his kind regards.*
(Lit.: He charged us to make to them his salutations.)	
Lúi se ne andò alle tre (= tre ore) e voi ve ne andaste alle quatro,	*He went away at three and you went away at four o'clock.*

VOCABULARY

mentre, *whilst.*
approvare, *to approve* (of).
andársene, *to go away.*
a più riprese, *on several occasions.*
dichiarare, *to declare.*
la guerra, *war.*
la notízia, *news.*
l'accordo (m.), *agreement.*
continuare, *to continue.*
l'impianto (m.), *plant* (machinery).
il macchinário, *machinery.*
la data, *date.*
il ragguáglio, *the particular, the detail, information.*

Exercise 21

Translate into English :—

1. Io parlavo al compratore mentre voi scrivevate ai debitori. 2. L'anno passato mentre lúi era ammalato, andái a Palermo per operare degl'incassi. 3. Egli approvò ciò che avevamo fatto. 4. M'incaricárono di farvi i loro saluti. 5. Vi pagárono il conto senza domandare lo sconto. 6. Leggemmo un'ora e poi ce ne andammo. 7. A più riprese si dichiarò pronto a saldare la somma dovuta loro. 8. Diteci quando assicuraste l'invío e per qual importo? 9. Gli dicemmo che l'anno scorso il nostro amico ebbe molte traversíe. 10. Non vi ricordaste delle difficoltà che avemmo per ottenere il pagamento da quei clienti?

Exercise 22

Translate into Italian :—

1. We examined (P. Def.) his patterns and offered him the prices which you will find on the list enclosed. 2. You read yesterday his letters and her replies. 3. We asked (charged) you to give them our kind regards and you promised to do so (it). 4. We had so many misfortunes in the year before the War that we lost all desire to continue to work with that market. 5. Why did you go away before finishing your correspondence? I had not the time to stop and do it for you, as you know, because my train left at four o'clock. 6. Did they go there last week with an estimate for a complete machinery plant (tr.: plant complete of machinery)? 7. We insured the shipment for the amount which you mention in your letter of the same date, i.e. five thousand Italian lire.

Key to Exercise 11

1. He prefers to give us another quality. 2. Finish me the letter, and then go home. 3. If you want some dye, here is some; take some of it for yourself. 4. There were many buyers at our warehouse (with us) yestérday. 5. There are none of them here at present. 6. He does not say anything about (mention) it in his correspondençe. 7. There is so much to tell you that I do not know where to begin. 8. There is a lot to do. 9. Here we are at your entire disposal. 10. If you go there, take a ticket for Venice. 11. What do they say about it in the market? 12. I am going to Rome and I am returning from there every week. 13. This gentleman goes there often; I see him there almost every day. 14. They always go in (enter) there together. 15. Do not take any notice of the impolite manners of that man.

Key to Exercise 12

1. Non vi (ci) pensate, non vale la pena. 2. Arriviamo all'ufficio alle nove della mattina e ne usciamo alle quattro del pomeriggio. 3. Andáteci e portátemele, come al sólito. 4. Cómprano le etichette per tutte le pezze e ce ne danno trecento. 5. Prende la léttera di cambio e la usa (*or:* e se ne serve) per saldare il conto. 6. Ci domándano di dir loro (*or:* dire a loro) dove si trova l'indirizzo. 7. Perchè non mi dite che l'acqua bolle adesso? 8. Perchè sono tanto occupato che non posso pensare ad altra cosa. 9. Vendéndogli tutte le merci, niente rimane loro. 10. Vi spiego quest'affare nella mia léttera di oggi. 11. Ha venduto loro tutta la mia consegna? 12. Finíscono l'estratto del nostro conto questa settimana. 13. Me lo dice, perchè sa che è vero. 14. Vi avverto che non posso atténdere (aspettare) più. 15. Che pensate della qualità di queste merci? (*a*) Non ne penso. (*b*) Non ci (vi) penso.

Key to Exercise 13

1. According to his wish, we always sent them f.o.b. Liverpool. 2. Let us explain this matter to them! 3. Do not pay them the amount; pay it to the cashier. 4. Here is the bill of exchange which they had drawn on the merchant; I give it to you now instead of to-morrow. 5. This quality pleases me; buy it for me at the same shop (warehouse). 6. Do me this favour, I beg of you. 7. I was told that his salary was increased by 10 per cent., is it true? 8. It is certainly correct, he told me so himself. 9. We were always at home at ten o'clock in the morning, and at three in the afternoon. 10. Are you sure to be there? 11. Tell him at once, we beg of you, and, if he wants other patterns, send him some by the next post.

Key to Exercise 14

1. Se la merce gli piace, dátegliene quanta più ne vuole. 2. Secondo (d'accordo a) il vostro desiderio, aspettavamo i campioni prima di dirvi cio che ne pensavamo. 3. Spiegátemi questo affare, per piacere. 4. Mi si dice che fabbricano questo artícolo. 5. Non mi pagate la somma oggi, pagátemela domani. 6. Non vedete i prezzi? Éccoli! 7. Ecco le cambiali da voi indicate. 8. Se questa qualità vi piace, compráteglíela. 9. Gli si è detto che il vostro salario può éssere aumentato del cinque por cento. 10. Voi dite che ve lo ha detto lúi stesso, ne siete sicuro? 11. Vi sentite molto male? Dítemi che avete. 12. Che ne pénsano loro?

Key to Exercise 15

1. He tells me that something extraordinary has been said to him. 2. We are already (*or:* have already been) paid the whole sum, and therefore we do not wish to complain about it any more. 3. What had been enough for him alone has not been sufficient for us four. 4. It has rained so much that we have not been able to go out even for a minute. 5. We got up early this morning, as we wished to begin our work as soon as possible. 6. Where is the copy of the policy? I have given it to you; do you not remember it? 7. He does not remember anything, he has said so to me himself so often. 8. We have said it to them, to him, to her and to you, but you all forget it always. 9. They have done this work for me and for you, in fact for us all, so to say. 10. I hope to see you safe and sound on your arrival here next week. 11. How long were they in the house, more than three hours? 12. Were you looking for your father or your cousin when we were in the theatre? 13. This balance of five hundred Italian lire constitutes exactly our invoice of 3rd April last.

A. C.

SPANISH.—XI

Subjunctive Mood.—By way of practice the student should fill in the remaining persons of the following irregular verbs in the present tense of the Subjunctive Mood :

Infinitive	*Pres. Indicative*	*Pres. Subjunctive*
dar, *to give*	doy, *I give*	dé, etc.
saber, *to know*	sé, *I know*	sepa, etc.
ser, *to be*	soy, *I am*	sea, etc.
ir, *to go*	voy, *I go*	vaya, etc.
haber, *to have*	he, *I have*	haya, etc.
estar, *to be*	estoy, *I am*	esté, etc.
venir, *to come*	vengo, *I come*	venga, etc. (3 plur. Past Def. is vinieron, Imp. Subj. viniese, etc.)
pedir, *to beg, ask for*	pido, *I beg, ask for*	pida, etc.
contribuir, *to contribute*	contribuyo, *I contribute*	contribuya, etc.
conducir, *to conduct*	conduzco, *I conduct*	conduzca, etc.
conocer, *to know*	conozco, *I know*	conozca, etc.
poner, *to put*	pongo, *I put*	ponga, etc.

Certain verbs, with regular endings throughout, alter the principal vowel of the stem, if " e " into " ie," if " o " into " ue " whenever the stress falls upon the " e " or " o," viz. in the Present Indicative, in the Present Subjunctive, and the Imperative.

The following verbs should be conjugated in the manner shown below, like **pensar** :—

acertar, *to guess.*
acrecentar, *to increase.*
apretar, *to squeeze.*
cerrar, *to shut.*
comenzar, *to commence.*
confesar, *to confess.*
despertar, *to awake.*
empezar, *to begin.*
encerrar, *to shut in.*
enmendar, *to correct.*
negar, *to deny.*
plegar, *to fold, to make up* (piece goods).
quebrar, *to break.*
recomendar, *to recommend.*
sentarse, *to sit down, seat oneself.*

The student should also, for the sake of exercise, conjugate the following verbs, like **acordar** :—

acordarse de, *to remember.*
recordar, *to remind, remember.*
aprobar, *to approve.*
comprobar, *to prove.*
contar, *to relate.*
costar, *to cost.*
encontrar, *to meet.*
probar, *to prove.*
renovar, *to renew.*
rogar, *to pray, beseech, request.*
trocar, *to exchange.*

Sentir and **dormir** not only make the vowel changes as in **pensar** and **acordar**, but change the " e " into " i," and " o " into " u " respectively, in the first and second persons pl. Present Subjunctive and third persons singular and plural of the Past Definite Indicative, as shown below.

The principal verbs conjugated like **sentir** are :—

adherir, *to adhere.*
adquirir, *to acquire.*
advertir, *to advise.*
arrepentirse, *to repent.*
conferir, *to confer.*
consentir, *to consent.*
diferir, *to delay.*
divertir, *to divert.*
mentir, *to lie* (tell a lie).
sugerir, *to suggest.*

This list will be completed in a future lesson.

Example

Pensar, *to think*

Present Indicative :	pienso	piensas	piensa	pensamos	pensáis	piensan
Present Subjunctive :	piense	pienses	piense	pensemos	penséis	piensen.
Imperative Affirmative :	—	piensa (tú)	piense (él, V.)	pensemos	pensad	piensen (ellos, Vs.).

N.B.—The Negative Imperative is taken entirely from the Present Subjunctive.

Acordar, *to grant, agree.*

Present Indicative :	acuerdo	acuerdas	acuerda	acordamos	acordáis	acuerdan.
Present Subjunctive :	acuerde	acuerdes	acuerde	acordemos	acordéis	acuerden.
Imperative :	—	acuerda (tú)	acuerde (él, V.)	acordemos	acordad	acuerden (ellos, Vs.),

Sentir, *to feel, to be sorry.*

Present Indicative :	siento	sientes	siente	sentimos	sentís	sienten.
Present Subjunctive :	sienta	sientas	sienta	sintamos	sintáis	sientan.
Past Definite :	sentí	sentiste	sintió	sentimos	sentistes	sintieron.

Dormir, *to sleep.*

Present Indicative :	duermo	duermes	duerme	dormimos	dormís	duermen.
Present Subjunctive :	duerma	duermas	duerma	durmamos	durmáis	duerman.
Past Definite :	dormí	dormiste	durmió	dormimos	dormistes	durmieron.

Orthographical Changes in Verbs.—Verbs make the following orthographical changes in order to retain the original pronunciation :—

(*a*) Verbs ending in **car** change the **c** into **qu** before an **e**, as sacar, *to draw* (a bill, etc.), saqué, *I drew.*

(*b*) Those in **gar** take a **u** after the **g** if an **e** follows, as pagar, *to pay*, pague, *let him pay.*

(*c*) Those in **zar** change **z** into **c** before **e**, as gozar, *to enjoy*, goce, *let him enjoy.*

(*d*) Those ending in **cer** or **cir** change the **c** into **z** before **a** or **o**, as vencer, *to fall due* (of a bill), *to conquer*, venzo, *I conquer*, etc., venza, *let him conquer, let it* (a bill) *fall due* ; resarcir, *to compensate*, resarzo, *I compensate*, resarza, *let him compensate.*

(*e*) Verbs ending in **ger** and **gir** change **g** into **j** before **a** or **o**, as escoger, *to choose, select*, escojo, *I choose*, escoja, *let him choose*, dirigir, *to direct*, dirijo, *I direct*, dirija, *let him direct.*

(*f*) Those ending in **aer**, **eer**, **oer**, change **i** of termination into **y** when between two vowels and not bearing the stress, as creer, *to believe*, creyendo, *believing*, creyó, *he believed*, creyeron, *they believed*, etc. ; but the Imperfect Indicative is creía, etc., *I believed*, etc., because the **i** in this instance bears the stress.

(*g*) Verbs in **-guir** (as **distinguir**, *to distinguish*), and **-quir** (as **delinquir**, *to offend against*) change the **gu** and **qu** into **g** and **c** respectively before **a** or **o**, as **distingo**, **distinga**, **delinco**, **delincamos**.

(*h*) Verbs having **ll** or **ñ** as last letters of the stem, drop the letter **i**, for the sake of euphony, in all terminations that begin with the diphthongs **ie**, **io**, as bullir, *to boil*, bulliendo, *boiling*, bulló, *it boiled* ; gruñir, *to grunt*, gruñendo, *grunting*, gruñó, *he grunted.*

Irregularities.—The following irregularities in conjugation should be noted by the student :—

	Future	Conditional
caber, *to be contained (in), to find room (in)*	cabré, etc	cabría, etc.
decir, *to say*	diré	diría
hacer, *to do, make*	haré	haría
poder, *to be able*	podré	podría
poner, *to put*	pondré	pondría
querer, *to wish*	querré	querría
saber, *to know*	sabré	sabría
salir, *to go out*	saldré	saldría
valer, *to be worth*	valdré	valdría
venir, *to come*	vendré	vendría

Examples

Escojo las calidades que me gustan más.
I choose the qualities I like best (the qualities which please me most).
Le pido á V. (que) venga á verme mañana.
I request you to come and see me to-morrow (after pedir, que is often omitted).
¿ No se acuerda V. de esta circunstancia ?
Do you not remember this circumstance ?
¡ Escoja V. el dibujo que le gusta más !
Choose the design you like best.

VOCABULARY

gustarle á uno, *to please someone, to like.*
el banco, *the bank.*
respecto á, *respecting, about.*
como, *how.*
á menudo, *often.*
más á menudo, *oftener.*
ésta (= esta ciudad), *this city.*
ésa (= esa ciudad), *that city* (that city where you are, i.e. your city).
aquélla (= aquella ciudad), *that city, where a third party resides.*
en orden, *in order.*
el revisor, *the auditor.*
el escritorio, *the office.*
la mitad, *the half.*
el viajero, *the traveller.*
á principios, *at the beginning.*
la pena, *the trouble.*
gastar, *to spend.*
semejante, *such.*
la friolera, la fruslería, la bagatela, } *the trifle.*
la especulación, *the speculation.*
la confianza, *the confidence.*
la letra, la libranza, } *the bill.*
el regreso, *the return.*
el vencimiento, *the maturity, due-date.*
la confusión, *the confusion.*
la reclamación, *the claim.*
la obra, *the work.*
en vez de, *instead of.*
la cortesía, *the courtesy.*
la deuda, *the debt.*
el giro, *the draft.*
el plazo, *the term* (credit, time to run).
largo (adj.), *long.*
correr, *to run.*
el líquido, *the liquid.*
el tintorero, *the dyer.*
el hilado, *the yarn.*

Exercise 19

Translate into English :—

1. Diremos al cajero que vaya al banco y que diga todo respecto á este negoció. 2. Vendré mañana y se lo explicaré á V. para que sepa como van las cosas. 3. Vengan Vs. á verme más á menudo y denme todas las noticias. 4. Querríamos que esos clientes viniesen (vinieran) á ésta dos veces cada año. 5. ¿ Que haría V. en mi lugar y qué quisiera (querría) que yo hiciera (hiciese) ? 6. Pondremos en orden los libros para la visita de los revisores de cuentas. 7. No cabría en nuestro despacho (escritorio) la mitad de estos muebles. 8. Nuestro viajante (viajero) saldrá á principios del año que viene. 9. No valdría la pena de gastar tanto tiempo con semejantes frioleras (fruslerías, bagatelas). 10. El podrá decírselo á Vs. cuando esté en ésa. 11. Sólo sabríamos qué hacer si V. nos lo dijese (dijera). 12. Confieso que es imposible que él sea el mismo hombre. 13. ¿ Se acuerda V. de esta circunstancia ? 14. Es mejor que no

Imperfect Indicative

ir, *to go :*	iba	ibas	iba	íbamos	ibais	iban	*I was going,* etc.
ser, *to be :*	era	eras	era	éramos	erais	eran	*I was,* etc.
ver, *to see :*	veía	veías	veía	veíamos	veíais	veían	*I was seeing,* etc.

entremos en tales especulaciones, para que durmamos en paz. 15. Es posible que dicha casa goce (Pres. Subjunctive) de mucha confianza en la plaza.

Exercise 20

Translate into Spanish :—

1. In case the bills fall due before my return, send (tr. put) me a telegram a week before their maturity. 2. These are the new designs, choose (pl.) those you like (gustar á) best. 3. I shall tell him to ask (that he ask—Subj.) his customers to accept (Subj.) the goods. 4. Let there be (Negative Imperative of " haber ") no confusion in this matter. 5. You will not want business (pl.) that leads (Subj. of " conducir ") to claims. 6. Whether (que) he know (Subj. of " conocer ") this person or not, let him direct to him the letter. 7. I come to (á) ask you, gentlemen, to contribute (Subj.) to this (= this so) good work. 8. Instead of replying to me with courtesy, he only grunted. 9. It is necessary that you should distinguish (Pres. Subj. of " distinguir ") between these two things. 10. Let us pay our debts, so that we may sleep in peace 11. I drew the draft with this due-date (maturity) so that you may profit by the long term the bill has to run. 12. Not believing that it was (Imperfect or Conditional Subj. of " ser ") the same design, I was not willing to accept the goods.

Key to Exercise 7

1. The small patterns (samples) will be sent next week. 2. We are not sending them to-day, because we have not (got) them. 3. By sending them to you then, you will receive them in time. 4. Please tell me your name. 5. What is good about this, is that it serves for always. 6. It is useless to trouble oneself about the past. 7. It is necessary to think about the future and leave the past. 8. Every morning I take a bath in cold water. 9. I have told them my way of thinking. 10. My friend tells me that he is employed in a Spanish shipping house. 11. If you have this article, please give it to us at the price mentioned. 12. We quoted you this price before the War. 13. Now the prices have risen very much. 14. These goods are not bought at less than five shillings per piece. 15. Many articles are sold here for South America. 16. In our office letters are written all day.

Key to Exercise 8

1. Si recibière las càrtas èsta mañàna, se las daré á V. 2. Èsto no es pàra mí, sìno pàra V. 3. Èsto no es pàra nosòtros, pèro aquèllo que ven en la mèsa. 4. Èste es su surtìdo de Vs., que se enviará èsta tàrde. 5. Mi cuènto se saldará y se pasará mañàna sin fàlta. 6. Èsta muèstra es la sùya, no es la mía. 7. Èste dibùjo es nuèstro y se lo darèmos á V. còmo lo quière. 8. ¿ De quién son èstos dibùjos ?—Míos. 9. Èstos géneros no puèden comparàrse con los nuèstros.

Key to Exercise 9

1. It is impossible to do this. 2. Our clerks study several languages and are very diligent. 3. My customer visited me the day before yesterday. 4. He used to visit me every month during last year. 5. Did you speak to (with) the cashier or with (to) the secretary? 6. When I used to go there, I always spoke with the head of the firm. 7. We were writing when you said that to us. 8. Nothing was missing and we were quite satisfied. 9. If you continue to be lazy, you will never be rich or happy, but always unhappy and poor. 10. What cloths (textiles) did the manufacturer produce? 11. This manufacturer produced the goods which we afterwards sold to our customers. 12. The mills produced all these pieces. 13. I have more employees now than I had last year. 14. The patterns which you had from your clients are very nice. 15. We should have more orders if we had sufficient capital. 16. I am in the warehouse all day. 17. After working all day we are very tired. 18. Will the goods be ready in time for the steamer ? 19. All your packages are already shipped. 20. Our letters are written by a very capable clerk.

Key to Exercise 10

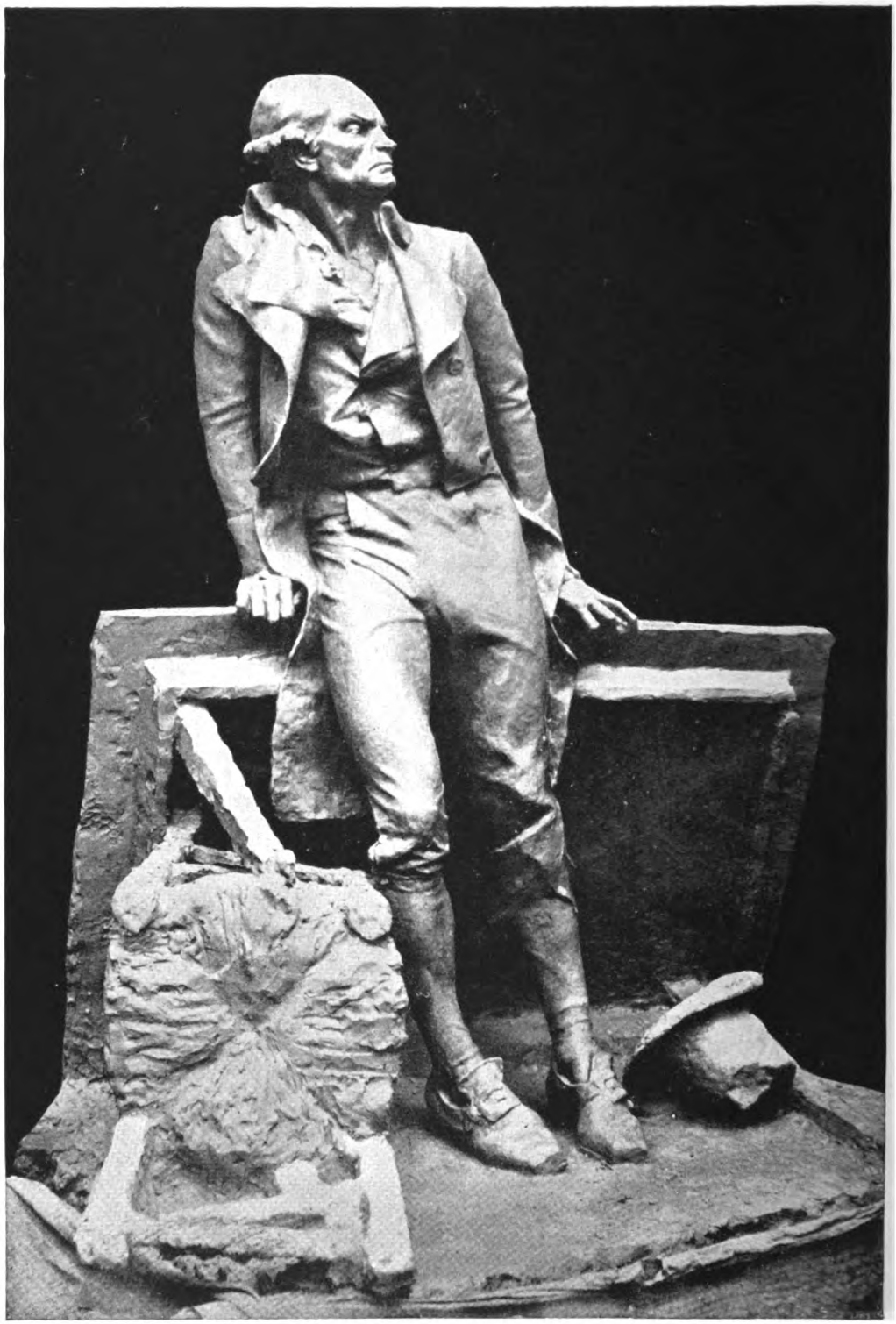
1. Sería imposible hacèr más que V. hàce. 2. ¿ Son mùy aplicàdos nuèstros empleàdos que estùdian divèrsas lènguas ? 3. ¿ Cuándo les visitàron á Vs. sus clièntes la última vez ? 4. Los dependièntes son vìvos y sus amìgos en el ejército francés están vìvos. 5. Me alègro mùcho al aprendèr (entendèr) que está V. buèno. 6. Amàmos mùcho á nuèstro cajèro, pòrque es buèno. 7. Es mejòr no comèr las frùtas cuàndo están vèrdes. 8. La mayòr pàrte (la mayoridàd) de las manzànas son vèrdes ; èste es su colòr naturàl. 9. ¿ Son èllos empleàdos de los Señòres Gonzàles y Compañía, y estàban sièmpre tan ocupàdos (empleàdos) còmo lo parècen ahòra ? 10. Pàgan mùy bièn, y en efècto son los mejòres clièntes del mùndo. 11. ¿ Es verdàd que Vs. tendrán ùna remèsa pàra nosòtros mañàna ? 12. ¿ Serán los géneros ya expedìdos mañàna ó pasàdo mañàna ? *or* ¿ Estarán los géneros ya expedìdos mañàna ó pasàdo mañàna ? 13. Estàmos cansàdos de estar ocupàdos tòdo el día y tòda la nòche. 14. Las Himalàyas están sièmpre cubiertàs de niève, tànto en el veràno còmo en el invièrno. 15. ¿ Cuándo estará V. aquí pàra hacèr el trabàjo que ha prometìdo ? 16. ¿ Cómo es que los géneros ya no están lìstos ? 17. Teníamos más tièmpo pàra estudiàr que lo que tenèmos ahòra. 18. Él tendrá mènos oportunidàdes en lo futùro que las que ha tenìdo hàsta ahòra. 19. Nàda fàlta sìno su presència pàra completàr nuèstra felicidàd. 20. Nàda faltó, y tòdos quedàron (estuvièron) satisfèchos.

Key to Exercise 11

1. Buy all the pieces in the market (place). 2. Do not sell anything for the moment. 3. When we send the packages, we will advise you of it. 4. Let us buy more machines. 5. Let them not sell anything without our advice. 6. I should like to know something. 7. Tell me whether you have received my letter. 8. If they wanted to do it, they would do it. 9. He asks us whether we wish to enter into business relations with him. 10. When shall you write to me ? 11. I shall write when I have the time to do so. 12. I should regret it exceedingly if they were to lose (lost) much money. 13. If you would (were willing to) do me this favour, I should be very grateful to you. 14. When you send us the remittance we shall forward you the goods.

Key to Exercise 12

1. Cuàndo vènda V. la tèla crùda, dígame el prècio. 2. No vènda V. nàda á mènos que cinco peniques la yàrda. 3. Si quisièse (quisièra) vendèr èse lòte, yo lo compraría. 4. Cuàndo èllos tengan el tièmpo, nos enviarán un extràcto de nuèstra cuènta. 5. Deseàmos que V. nos diga la verdàd. 6. Quièro (Desèo) contàrle á V. tòda la istòria. 7. Nos querían (quisièran) decìr ùna palàbra. 8. ¡ Dígamelo V. ahora, o no me lo diga nunca jamás ! 9. Si Vs. les dan á èllos el pedìdo, harán tòdo lo posible pàra ejecutàrlo. 10. Deseàmos recibir la muèstra á vuèlta de corrèo. 11. Si compràse tan baràto, haría un beneficio de dièz por ciènto. 12. ¡ No lo diga V., pòrque no es verdàd ! A. C.



THE SEA GREEN INCORRUPTIBLE.

A striking statue at the Hôtel de Ville de St. Ouen, near Paris, of Maximilien Robespierre, the sphinx of the French Revolution. Of Irish descent, Robespierre was born at Arras, in 1758. He died in 1794, a victim—not unjustly, perhaps—of the guillotine which he had used with such terrible effect (*see* pp. 442 *sqq.*).

Continued from page 356.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.

(M. A. Lewenz, M.A.[Lond.]).

MECHANICS.—XIV

85. **Couples.**—Two equal unlike parallel forces whose line of action is not the same form a couple.

A couple tends to rotate a rigid body and therefore cannot keep it in equilibrium. The **arm** of a couple is the perpendicular distance between the lines of action of the two forces.

Thus the arm of the couple (P, P) is the length A B.

Examples of a couple are furnished by the winding of a clock by means of a key (the key is turned by a couple) and the turning of the handle of a door.

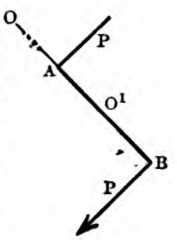


Fig. 71.

The **moment** of a couple is the algebraic sum of the moments of its two components about any point in their plane.

The moment of a couple is the same about all points in its plane.

Consider the couple formed by the forces P and −P in Fig. 71. Let O be any point in their plane and draw O A B perpendicular to the forces. Then if O does not lie between A and B, the algebraic sum of the moments of the forces

$= P \cdot OB - P \cdot OA = P(OB - OA) = P \times AB.$

If O lies between A and B (as at O^1), the algebraic sum of the moments of the forces

$= P \cdot O^1B + P \times O^1A$

$= P(O^1B + O^1A) = P \times AB$

Hence the moment of the couple is independent of the position of O.

We may consequently define the **moment** of a couple as **the product of either force and the arm of the couple.**

86. *Two couples in the same plane whose moments are equal and opposite, balance one another.*

Let one couple consist of the forces (P, P) acting at the ends of an arm p, and the other of the forces (Q, Q) acting at the ends of an arm q (Fig. 72).

CASE 1. Let one of the forces P meet one of the forces Q in a point O^1 and let the other two forces meet at O^1.

From O^1 draw the perpendiculars O^1M and O^1N.

Then $O^1M = p$ and $O^1N = q$.

Since the moments of the couples are equal in magnitude.

$P \times p = Q \times q$, i.e. $P \times O^1M = Q \times O^1N$

Hence O^1 is on the line of action of the resultant of P and Q acting at O, thus the direction in which this resultant acts is $O\,O^1$.

Similarly the direction of the resultant of P and Q acting at O^1 is $O^1\,O$.

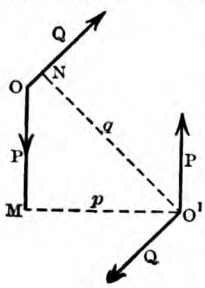


Fig. 72.

Now these resultants are equal in magnitude for the forces at O and at O^1 are equal and act at the same angle.

Hence the two resultants are equal and opposite and therefore balance one another, i.e. the four forces forming the two couples are in equilibrium.

CASE 2. Let the forces composing the couples be all parallel, and let any straight line perpendicular to them all meet them in points A, B, C, D, as in Fig. 73.

Then since the moments are equal $P \times AB = Q \times CD$ (i)

Let O be the point of application of the resultant of Q at C and P at B

Then $P \times BO = Q \times CO$. (ii)

Subtracting (ii) from (i) we have

$P \times AO = Q \times OD$

so that O is also the point of application of the resultant of P at A and Q at D.

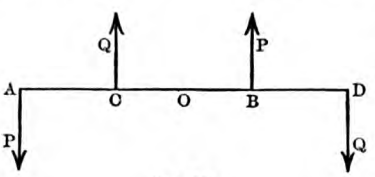


Fig. 73.

Now these resultants are equal in magnitude, for each $= P + Q$, and they are opposite in direction; therefore they are in equilibrium.

Hence the four forces forming the two couples are in equilibrium.

It follows from the above that *any two couples of equal moment in the same plane are equivalent.*

87. *A single force and a couple acting in the same plane on a rigid body are equivalent to the single force acting in a direction parallel to the original direction.*

Let the couple consist of two forces each equal to P, whose lines of action are O A and O^1 B respectively. Let the single force be Q.

CASE 1. If Q be not parallel to the forces of the couple, let it be produced to meet one of them at O.

Then P and Q acting at O are equivalent to some force R acting in some direction O D lying between O C and O A (Fig. 74).

Let O D be produced (backwards if necessary) to meet the other force P of the couple in O^1 and let the point of application of R be transferred to O^1. Draw $O^1 C^1$ parallel to O C.

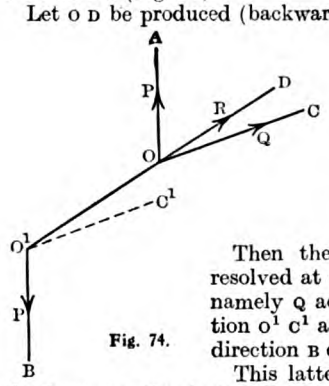


Fig. 74.

Then the force R may be resolved at O^1 into two forces, namely Q acting in the direction $O^1 C^1$ and P acting in the direction B O^1.

This latter force P balances the force P acting in the direction O^1 B.

Hence we have left the resultant, a force Q acting at O^1 in a direction parallel to its original direction.

CASE 2. If Q be parallel to one of the forces of the couple, let O^1 O meet the force Q in L.

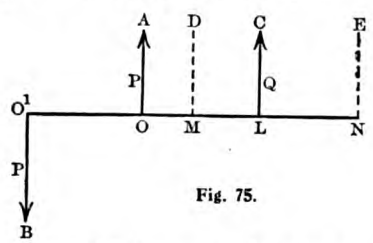


Fig. 75.

The like parallel forces P and Q at O and L are equivalent to a force (P + Q) acting at some point M in a direction parallel to O A. Again the unlike parallel forces P at O^1 and (P + Q) at M are equivalent to a force (P + Q − P) = Q at some point N in a direction N E parallel to M D.

Hence the resultant is a force Q acting at N in a direction parallel to its original direction.

88. Equilibrium of a rigid body acted on by three forces in a plane.

If three forces acting in one plane upon a rigid body be in equilibrium, they must either meet in a point or be parallel.

If the forces all be parallel, then since they are in equilibrium the resultant of two of the forces must be equal and opposite to the third force and must act through the same point.

If the forces be not all parallel, at least two must meet in a point.

Let the forces P and Q meet in O. Then the resultant of P and Q must be a force whose line of action passes through O.

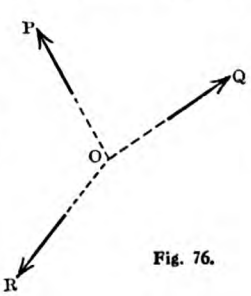


Fig. 76.

But since P, Q and R are in equilibrium, this resultant must balance R, and two forces cannot balance unless they have the same line of action. Therefore the line of action of R must pass through O.

89. We may sum up the conditions of equilibrium of a rigid body acted on by coplanar forces, thus:

1. *Two forces.*

These forces must

(*a*) be equal in magnitude, and

(*b*) be opposite in direction, and

(*c*) act through the same point.

2. *Three forces.*

These forces must

(*a*) act through the same point and be capable of representation by the sides of a triangle taken in order, or

(*b*) be parallel, and the resultant of two of them must be equal and opposite to the third and act through the same point.

3. *Several forces.*

These forces must

(*a*) act through the same point and be capable of representation by the sides of a closed polygon taken in order, or

(*b*) be parallel, and their algebraic sum must vanish, as must the algebraic sum of their moments about any point, or

(*c*) act at different points and in different directions, and the algebraic sum of their components resolved in two directions (usually at right angles) must vanish, as must the algebraic sum of their moments about any point.

The conditions of 3 cannot be investigated in this course, but it has been thought desirable that the student should note them.

In the following examples we shall assume that the weight of the bodies dealt with acts at a certain point called the **centre of gravity.**

90. Examples:—

(1) A uniform rod x feet long, weighing w lb., is laid on a table with y inches projecting over the edge. What weight can be suspended from the projecting end of the rod before the rod will be pulled over?

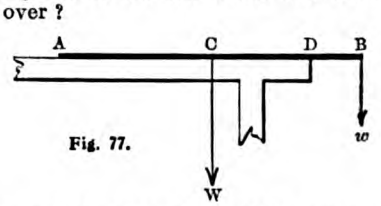


Fig. 77.

Let A B be the rod, C its middle point and D B the part projecting over the table.

Let w be the greatest weight that can be suspended at B before the rod will be pulled over.

A B $= x$ feet $\therefore$ C B $= \frac{x}{2}$ ft.

Also D B $= \frac{y}{12}$ ft. $\therefore$ C D $= \left(\frac{x}{2} - \frac{y}{12}\right)$ ft.

The weight W of the rod will act downwards at C.

The weight w will tend to make the rod rotate about the point D in a clockwise direction.

As long as there is equilibrium the moments of W and w about D must be equal and opposite.

Thus we have

W × C D = w × B D

i.e. W $\left(\frac{x}{2} - \frac{y}{12}\right) = w \times \frac{y}{12}$

Hence $w = 12\,\frac{W}{y}\left(\frac{x}{2} - \frac{y}{12}\right) = \frac{W}{y}(6x - y)$

(2) A heavy uniform rod A B of weight W is hinged at A to a fixed point and is kept in a position inclined at an angle of 60° to the horizontal by the action of a horizontal force F acting at B, the lower end. Find the magnitude of F and the action of the hinge.

Let the middle point of the rod be C. Then the weight W will act vertically downwards through C (Fig. 78).

Let the line of action of W cut the line of action of F at D.

Then C D and D B are perpendicular. There are three forces acting on the rod, viz.: the horizontal force F, the weight W, and the unknown reaction R at the hinge A.

Since the rod is in equilibrium, F, W and R must pass through one point, hence the line of action of R passes through D, since F and W intersect at D.

Thus the line of action of R is D A.

Draw A E perpendicular to E B, and let the angle E D A be θ.

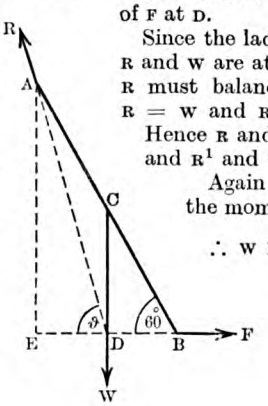


Fig. 78.

Then A D E is the triangle of forces, since its sides are parallel to the forces.

Hence we can measure θ, and we have

$\frac{W}{AE} = \frac{F}{ED} = \frac{R}{AD} \therefore F = \frac{ED}{AE}W$

and $R = \frac{AD}{AE}$ W acting at an angle inclined θ° to the horizontal.

Now $ED = \frac{1}{2}EB$

and $AE = \sqrt{3}\,EB$ since $ABE = 60°$

$\therefore F = \frac{W}{2\sqrt{3}} = \frac{\sqrt{3}\,W}{6}$

And $AD = \sqrt{AE^2 + ED^2} = \sqrt{3\,EB^2 + \frac{1}{4}EB^2} = \frac{\sqrt{13}\,EB}{2}$

$\therefore R = \frac{\sqrt{13}}{2\sqrt{3}}W = \frac{\sqrt{39}\,W}{6}$ acting at an angle inclined θ° to the horizontal.

(3) A ladder of weight W acting at a point one-third of the ladder's length from the foot, rests against a smooth vertical wall and is inclined to it at an angle of 30° by a force applied horizontally to the foot. Find the force.

Let A B be the ladder with its foot A on the ground and its other end B resting against the smooth vertical wall B C (Fig. 80).

The forces acting on the ladder are:

F acting horizontally at A,

R acting vertically upward, the reaction of the ground on the ladder at A,

R^1 acting horizontally, the reaction of the wall on the ladder at B,

W acting vertically downward at G where A G $= \frac{1}{3}$ A B.

Let the line of action of W cut the line of action of F at D.

Since the ladder is in equilibrium and the forces R and W are at right angles to the forces F and R^1, R must balance W and R^1 must balance F, i.e. R = W and R^1 = F.

Hence R and W form a couple whose arm is A D and R^1 and F form a couple whose arm is B C.

Again since the ladder is in equilibrium, the moments of these couples must vanish.

$\therefore W \times AD = F \times BC \therefore F = \frac{AD}{BC}W.$

Now $AD = \frac{1}{3}AC$

and $BC = \sqrt{3}\,AC \therefore F = \frac{W}{3\sqrt{3}}$

$= \frac{\sqrt{3}\,W}{9}$

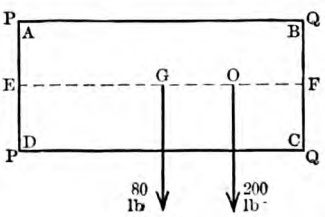


Fig. 79.

(4) A four-legged table weighs 80 lb. A weight of 200 lb. is placed midway between the sides and 6 feet and 2 feet respectively from the ends. Find the pressure of each leg on the floor.

Let A B C D be the table. We assume the pressure of the leg at A = pressure of leg at D and also pressure of leg at B = pressure of leg at C (Fig. 79).

Let the pressure at A be P and the pressure at B be Q.

Then the reaction of the floor on the table at A and D = P and the reaction of the floor on the table at B and C = Q

The resultant of P at A and P at D is a force 2P acting vertically upwards at E, the mid-point of A D.

The resultant of Q at B and Q at D is a force 2Q acting vertically upwards at F, the middle point of B C.

Further the weight 80 lb. acts vertically downwards at G the mid-point of E F, and the weight of 200 lb. acts vertically downwards at O where O F = 2 ft. and O E = 6 ft. These four forces are in equilibrium, hence the sum of their moments about any point is zero.

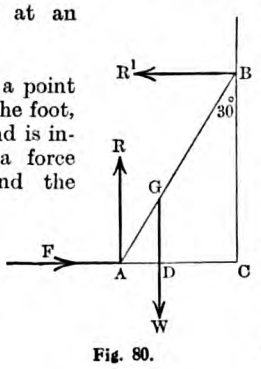


Fig. 80.

Take moments about F.

Then $2P \times EF - 80 \times GF - 200 \times OF = 0$

$2P \times 8 - 80 \times 4 - 200 \times 2 = 0$

$\therefore P = 45$

Take moments about E

Then $2Q \times FE - 200 \times OE - 80 \times GE = 0$

$2Q \times 8 - 200 \times 6 - 80 \times 4 = 0$

$\therefore Q = 95$

Hence the pressure at A and B = 45 lb. and at B and C = 95 lb.

Exercise 15

(1) Forces P, 2P, 3P, 4P, act along the sides of a square A B C D taken in order. Find the magnitude direction and line of action of their resultant.

(2) A uniform heavy beam weighing 60 lb. rests horizontally on two supports, one at one end of the beam and one 3 feet from the other end. The total length of the beam is 8 ft. Find the greatest weight that can be hung on the projecting end without upsetting the beam.

(3) Two men carry a uniform heavy beam 15 feet long. One man supports it at a distance $1\frac{1}{2}$ ft. from one end and the other at a distance of $3\frac{1}{2}$ ft. from the other end. They support weights of 48 and 72 lb. respectively. What is the weight of the beam?

(4) A rod 14 feet long and weighing 80 lb. has two weights, one of 60 lb. and the other of 100 lb., suspended at a distance of 1 ft. from either end. Find where the rod must be supported in order that it may balance on the support.

(5) A weightless rod A B, hinged at A, is supported in a horizontal position by a string B C making an angle of 45° with the rod; also the rod has a weight of 10 lb. suspended at B. Find the tension in the string and the action at the hinge.

(6) A uniform rod can turn freely about one of its ends, and is pulled aside from the vertical by a horizontal force acting at the other end and equal to half its weight. At what inclination to the vertical will the rod rest?

Key to Exercise 14

(1) (*a*) 16 lb. at distances of 6 ft. and 2 ft. from the components.

(*b*) 25 lb. at distances of 3 ft. and 2 ft. from the components.

(*c*) 20 gms. at distances of 144 cm. and 36 cm. from the components.

(2) (*a*) 8 lb. at distances of 12 ft. and 4 ft. from the components.

(*b*) 5 lb. at distances of 10 ft. and 15 ft. from the components.

(*c*) 12 gms. at distances of 240 cm. and 60 cm. from the components.

M. A. L.

TRIGONOMETRY.—VIII

71. The Solution of Triangles which we shall now consider involves the use of logarithms. In the examples set for solution we shall give the necessary logarithms of the trigonometrical ratios. For the logarithms of the natural numbers, students who do not possess Mathematical Tables are referred to the tables of logarithms and antilogarithms given on pages 230, 231; but as these are only worked to four places of decimals, the results obtained may differ slightly from those given in the key. The latter are obtained by the use of logarithms worked to seven places of decimals, and this of course gives more accurate results.

In the solution of triangles we have to consider four cases.

72. Case 1. *Given one side and any two angles of a triangle, to solve the triangle.*

Let the side a and the angles B and C be given, to find b, c and A.

$A = 180° - B - C$.

Also $\frac{b}{\sin B} = \frac{a}{\sin A}$ $\therefore b = \frac{a \sin B}{\sin A}$

$\therefore \log b = \log a + \log \sin B - \log \sin A$.

Similarly $\log c = \log a + \log \sin C - \log \sin A$.

Example:—

Given $a = 5043{\cdot}04$, $B = 84° 56' 14''$, $C = 58° 45' 33''$, find b, c and A.

$A = 180° - 84° 56' 14'' - 58° 45' 33''$

$= 36° 18' 13''$

$\log b = \log a + \log \sin B - \log \sin A$

$\log a = \log 5043{\cdot}04$

$\log 5043{\cdot}0 = 3{\cdot}7026890$

difference for $4 = {\cdot}0000035$

$\therefore \log 5043{\cdot}04 = 3{\cdot}7026925$

$\log \sin B = \log \sin 84° 56' 14''$

L sin $84° 56' = 9{\cdot}9982997$

difference for $60' = {\cdot}0000112$

$\therefore$ difference for $14'' = {\cdot}0000026$

$\therefore$ L sin $84° 56' 14'' = 9{\cdot}9982997 + {\cdot}0000026$

$= 9{\cdot}9983023$

$\therefore \log \sin 84° 56' 14'' = \bar{1}{\cdot}9983023$

$\log \sin A = \log \sin 36° 18' 13''$

L sin $36° 18' = 9{\cdot}7723314$

difference for $60'' = {\cdot}0001719$

$\therefore$ difference for $13'' = {\cdot}0000372$

$\therefore$ L sin $36° 18' 13'' = 9{\cdot}7723314 + {\cdot}0000372$

$= 9{\cdot}7723686$

$\therefore \log \sin 36° 18' 13'' = \bar{1}{\cdot}7723686$

$\log b = 3{\cdot}7026925 + \bar{1}{\cdot}9983023 - \bar{1}{\cdot}7723686$

$= 3{\cdot}7009948 - \bar{1}{\cdot}7723686$

$= 3{\cdot}9286262.$

Now $3{\cdot}9286263 = \log 8484{\cdot}5$

$\therefore \log b = \log 8484{\cdot}5$ $\therefore b = 8484{\cdot}5$.

Again $\log c = \log a + \log \sin C - \log \sin A$.

Now $\log \sin C = \log \sin 58° 45' 33''$

L sin $58° 45' = 9{\cdot}9319213$

difference for $60'' = {\cdot}0000767$

$\therefore$ difference for $33'' = 0000422$

$\therefore$ L sin $58° 45' 33'' = 9{\cdot}9319635$

$\therefore \log \sin 58° 45' 33'' = \bar{1}{\cdot}9319635$

$\therefore \log c = 3{\cdot}7026925 + \bar{1}{\cdot}9319635 - \bar{1}{\cdot}7723686$

$= 3{\cdot}6346560 - \bar{1}{\cdot}7723686$

$= 3{\cdot}8622874.$

Now $3{\cdot}8622865 = \log 7282{\cdot}6$

let $3{\cdot}8622874 = \log (7282{\cdot}60 + d)$

$3{\cdot}8622924 = \log 7282{\cdot}7$

$\therefore 59 : 9 :: {\cdot}1 : d$

$\therefore d = {\cdot}01$

$\therefore 3{\cdot}8622874 = \log 7282{\cdot}61 = \log c.$

Hence $A = 36° 18' 13''$, $b = 8484{\cdot}5$, $c = 7282{\cdot}61$.

73. Case 2. *Given two sides and the included angle, to solve the triangle.*

Let the sides b and c and the angle A be given, to find a, B and C.

$$\tan \frac{B - C}{2} = \frac{b - c}{b + c} \cot \frac{A}{2}$$

$$\therefore \log \tan \frac{B - C}{2} = \log (b - c) + \log \cot \frac{A}{2} - \log (b + c),$$

From this we can find $\frac{B - C}{2}$.

Now we know $\frac{B+C}{2} = 90° - \frac{A}{2}$.

Hence we can find B and C.

After that, as in case 1, $\log a = \log b + \log \sin A - \log \sin B$.

An alternative method may be used to determine a by means of a subsidiary angle, thus:

$$a^2 = b^2 + c^2 - 2bc \cos A$$
$$= b^2 - 2bc + c^2 + 2bc\,(1 - \cos A)$$
$$= (b \dot{-} c^*)^2 + 4bc \sin^2 \frac{A}{2}$$
$$= (b \dot{-} c)^2 \left\{1 + \frac{4bc}{(b \dot{-} c)^2} \sin^2 \frac{A}{2}\right\}.$$

Now put $\tan \theta = \frac{4bc}{(b \dot{-} c)}$

$$= \sin^2 \frac{A}{2}.$$

Then we have

$a^2 = (b \dot{-} c) \sec \theta$

Example:—

Given $A = 40°$, $b = 131$, $c = 72$, find B, C and a.

$$\log \tan \frac{B-C}{2}$$
$$= \log (b - c) - \log (b + c) + \log \cot \frac{A}{2}$$
$$= \log 59 - \log 203 + \log \cot 20°$$
$$= 1{\cdot}7708520 - 2{\cdot}3074960 + {\cdot}4389341$$
$$= \bar{1}{\cdot}9022901.$$

$\therefore$ L $\tan \frac{B-C}{2} = 9{\cdot}9022901.$

Now L $\tan 38° 36' = 9{\cdot}9021604$

$\cdot 0002591$ = difference for $60''$

$9{\cdot}9022901 - 9{\cdot}9021604 = 0001297 =$ difference for $\frac{1297}{2591} \times 60'' = 30''$

$\therefore$ $9{\cdot}9022901 =$ L $\tan 38° 36' 30''$

$= $ L $\tan \frac{B-C}{2}$

Hence $B - C = 77° - 13'$.

Now $B + C = 180° - A = 140°$

$\therefore$ $B = 108° 36' 30''$

and $C = 31° 23' 30''$.

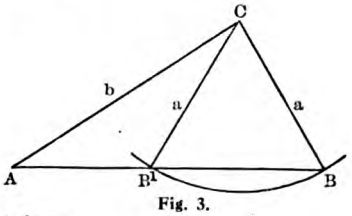


Fig. 3.

Again $\log a$

$= \log b + \log \sin A - \log \sin B$

$= \log 131 + \log \sin 40° - \log \sin 108° 36' 30''$

$= \log 131 + \log \sin 40° - \log \sin 71° 23' 30''$

$= 2{\cdot}1172713 + \bar{1}{\cdot}8080675 - \bar{1}{\cdot}9766810$

$= 1{\cdot}9486578 = \log 88{\cdot}8501.$

Hence B = 108° 36′ 30″

C = 31° 23′ 30″

a = 88·8501.

*$b \dot{-} c$ denotes the difference between b and c, i.e. $b \dot{-} c = b - c$ if $b > c$, and $b \dot{-} c = c - b$ if $c > b$.

74. Case 3. *Given two sides and the angle opposite one of them, to solve the triangle.*

Let the sides a and b and the angle A be given, to find c, B and C.

$\frac{\sin B}{\sin A} = \frac{b}{a}$ $\therefore$ $\sin B = \frac{b}{a} \sin A$

$\therefore$ $\log \sin B = \log b - \log a + \log \sin A$.

Knowing B, we have $C = 180° - A - B$.

And lastly $c = \frac{a \sin C}{\sin A}$

$\therefore$ $\log c = \log a + \log \sin C - \log \sin A$.

However, the equation $\sin B = \frac{b}{a} \sin A$ does not always give a definite result, for there may be two angles B satisfying this equation, one the supplement of the other.

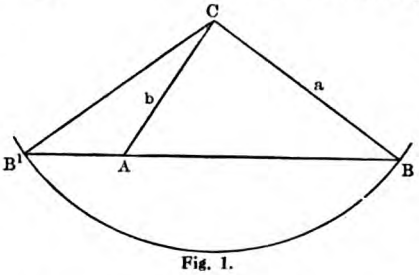


Fig. 1.

The following cases occur:

(i) $a > b$, then A > B, and therefore the smaller of the two angles which satisfy the equation must be taken, for if the greater angle were taken there would be two obtuse angles in the triangle, which is impossible (Fig. 1).

(ii) $a = b$, then A = B, and therefore again the smaller of the two angles which satisfy the equation must be taken, for the same reason as in (i) (Fig. 2).

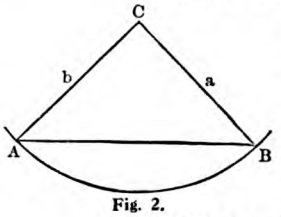


Fig. 2.

(iii) $a < b$ then A < B. Here there are three sub-cases to consider according as a is greater than, equal to, or less than, $b \sin A$.

If $a > b \sin A$, then since $\sin B = \frac{b \sin A}{a}$, the expression for $\sin B$ is a proper fraction, and both values obtained for B are admissible. Hence there are two triangles which satisfy the given conditions, in which the angle B of one triangle is the supplement of the angle B of the other. This is known as the **ambiguous** case in the solution of triangles.

If $a = b \sin A$, then $\sin B = 1$, and therefore

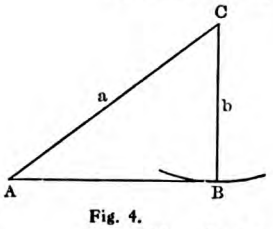


Fig. 4.

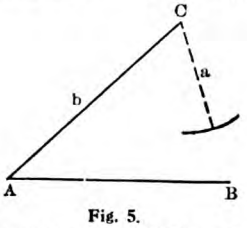


Fig. 5.

$B = 90°$. Now the supplement of 90° is 90°, hence we have two coincident triangles which satisfy the conditions. But as the triangles are coincident, i.e. equal in all respects, the two solutions are identical and consequently there is no ambiguity.

If $a < b \sin A$, then the expression for $\sin B$ is greater than unity, and hence there is no real value for B. Consequently no triangle exists which satisfies the given conditions, and there is no solution.

75. The third case in the solution of triangles may be illustrated geometrically thus.

Let A C = b, and angle C A B = A. With centre C and radius = a describe a circle cutting B A or B A produced in B and B′.

(i) $a > b$, then B and B′ are on opposite sides of A, and there is only one triangle, namely C A B, having the given angle A and the given sides a and b.

(ii) $a = b$, then B′ coincides with A and there is only one triangle C A B which has the given angle A and the given sides a and b (Fig. 2).

(iii) $a < b$

if $a > b \sin \alpha$, then C B is greater than the perpendicular distance of C from A B, and the circle cuts the line A B in two real points B and B′, both on the same side of A (Fig 3).

Then there are two triangles C A B, C A B′ having the given angle A and the given sides a and b, and the angles C B A and C B′ A in these two triangles are supplementary.

If $a = b \sin \alpha$, then C B is the perpendicular distance of C from A B and the circle cuts the straight line A B in two real points B and B′ which coincide, i.e. the circle touches the straight line A B at B. Then there are two coincident triangles right angled at B which satisfy the given conditions, i.e. the triangle C A B has the given angle A and the given sides a and b (Fig. 4).

If $a < b \sin \alpha$, then C B is less than the perpendicular distance of C from A B and the circle will cut A B in two imaginary points ; i.e. there will be no real triangle having the angle A and the sides a and b (Fig. 5).

76. These results may also be obtained algebraically.

$a^2 = b^2 + c^2 - 2bc \cos A$.

This is a quadratic equation in c, whence

$c = b \cos A \pm \sqrt{b^2 \cos^2 A - b^2 + a^2}$

and this may be written

$b \cos A \pm \sqrt{a^2 - b^2 \sin^2 A}$.

Thus we have two values for c and we have the following cases :

(i) $a > b$, then $\sqrt{a^2 - b^2 \sin^2 A} > \sqrt{b^2 - b^2 \sin^2 A}$

i.e. $\sqrt{a^2 - b^2 \sin^2 A} > b \cos A$

and since c must have a positive value we must take the + sign before the radical.

Hence there is only one solution, i.e. only one triangle satisfying the conditions.

(ii) $a = b$, then $\sqrt{a^2 - b^2 \sin^2 A} = \sqrt{b^2 - b^2 \sin^2 A} = b \cos A$.

Hence the values of c are $2b \cos A$ and 0 ; i.e. there is only one triangle satisfying the conditions.

(iii) $a < b$, then $\sqrt{a^2 - b^2 \sin^2 A} < b \cos A$.

Hence there are two values of c, for we can take either the positive or the negative sign before the radical. Now these values of c are either real and different, or real and equal, or imaginary and different according as $a > b \sin A$, $a = b \sin A$ or $a < b \sin A$.

77. Case 4. *Given three sides of a triangle, to solve the triangle.*

$$\tan \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$$

$$\therefore \log \tan \frac{A}{2} = \tfrac{1}{2}\{\log (s-b) + \log (s-c) - \log s - \log (s-a)\}.$$

Similarly $\log \tan \frac{B}{2} = \tfrac{1}{2}\{\log (s-c) + \log (s-a) - \log s - \log (s-b)\}$.

From these A and B are found and C = 180° − A − B.

Example :—

Given $a = 4090$, $b = 3850$, $c = 3811$, to find A, B and C.

$\log \tan \frac{A}{2}$

$= \tfrac{1}{2}\{\log (s-b) + \log (s-c) - \log s - \log (s-a)\}$

$= \tfrac{1}{2}\{\log 2025{\cdot}5 + \log 2064{\cdot}5 - \log 5875{\cdot}5 - \log 1785{\cdot}5\}$

$= \tfrac{1}{2}\{3{\cdot}3065322 + 3{\cdot}3148149 - 3{\cdot}7690448 - 3{\cdot}2517599\}$

$= \tfrac{1}{2}$ of $\bar{1}{\cdot}6005424 = \bar{1}{\cdot}8002712$.

Now $\bar{1}{\cdot}8002712 = \log \tan 32° 16$

$\therefore \frac{A}{2} = 32° 16' \therefore A = 64° 32'$.

Again $\log \tan \frac{B}{2}$

$= \tfrac{1}{2}\{\log 2064{\cdot}5 + \log 1785{\cdot}5 - \log 5875{\cdot}5 \log 2025{\cdot}5\}$

$= \tfrac{1}{2}$ of $\bar{1}{\cdot}4909978$

$= \bar{1}{\cdot}7454989 = \log \tan 29° 5' 52''$

$\therefore \frac{B}{2} = 29° 5' 52''$

$\therefore B = 58° 11' 44''$

$\therefore C = 180° - 64° 32' - 58° 11' 44'' = 57° 16' 16''$

$\left.\begin{array}{l} A = 64° 32' \\ B = 58° 11' 44'' \\ C = 57° 16' 16'' \end{array}\right\}$.

Exercise 15

Solve the triangles of which the following elements are given :

(1) $c = 38$, A = 48°, B = 54°

L sin 54° = 9·9079576, L sin 48° = 9·8710735, L sin 78° = 9·9904044.

(2) $a = 6508$, B = 66° 40′, C = 25° 32′ 15″

L sin 66° 40′ = 9·9629449, L sin 25° 32′ 15″ = 9·6345798, L sin 87° 47′ 45° = 9·9996662.

(3) $c = 5043$, B = 127° 54′ 30″, A = 18° 56′ 20″

L sin 127° 54′ 30″ = 9·9870741, L sin 18° 56′ 20″ = 9·5112943, L sin 33° 9′ 10″ = 9·7378868.

(4) $a = 275{\cdot}35$, $b = 189{\cdot}28$, $c = 301{\cdot}47$

L tan 31° 45′ 28″ = 9·7916995, L tan 18° 59′ 10″ = 9·5366287.

(5) $a = 200{\cdot}4$, $b = 295{\cdot}3$, $c = 311{\cdot}1$

L tan 19° 14′ 31″ = 9·5179256, L tan 33°, 14′ 41″ = 9·7389487.

(6) $a = 743$, $b = 825$, A = 75° 10′ 55″

L sin 75° 18′ 55″ = 9·9853111.

Key to Exercise 14

(11) $\frac{3}{5}\sqrt{5}, \frac{2}{5}\sqrt{5}, \frac{\sqrt{2}}{2}; \frac{\sqrt{10}}{10}, \frac{\sqrt{5}}{5}, \frac{\sqrt{2}}{2}$.

(12) 135°, 30°, 15°.

M. A. L.

Continued from page 349.

GEOGRAPHY:

Contributors:—Robert Finch, F.R.G.S.; W. H. Koebel; Sir John Scott-Keltie, LL.D.; Cyril J. Silverston, B.Sc.(Lond.).

EUROPE.—I

It is scarcely necessary to explain that the importance of Europe lies rather in the peoples who inhabit it than in its area as a continent, for in actual size it is the smallest of all, with the exception of Australasia. Physically, Europe must rank as an extension of Asia, jutting out to the west to its frontiers on the Atlantic Ocean.

This vast body of water, it should be said, has made extensive inroads into the continent of Europe. Previous to its encroachments Holland, Denmark and the east coast of England were all united, while the Baltic was merely an inland sea.

Europe contains no peculiarly vast natural features. Its highest mountain, Mont Blanc, for instance, barely attains to the half of the altitude of some of the world's loftiest peaks, and in rivers, lakes, cataracts and the remaining natural features it can boast of nothing approaching a record. The continent, indeed, would seem to aspire to moderation in all physical things, and this applies in a notable degree to its climate.

Climate

The climate of Europe is one that is peculiarly adapted to the progress of civilisation, for it is more even and temperate than that of any other continent, and in consequence is admirably adapted for the development of that energy which has displayed itself in every direction of European life.

It is true that the northern extremities of Europe, as exemplified in Russia, Norway and Sweden, fall within the Arctic circle. But the population of these regions being for practical purposes non-existent, the influence of these territories on industrial Europe is nil. In the South of Spain, and the Algarve Province in the south of Portugal too, the climatic conditions do not represent those of Europe proper, and it is for this reason that the Algarve Province is known as the "European Africa." But here, again, the area affected is so small that it is entirely without influence on the continent in general.

In the west of the continent the prevailing winds are westerly, and it is here that the greatest degree of moisture is experienced. Proceeding eastwards, the climate becomes steadily less moist, and this condition of affairs is accentuated as the heart of the Great Central Plain is reached, until on the wide stretches to the north of the Caspian the climate becomes really arid, and many areas here assume an appearance that suggests a desert.

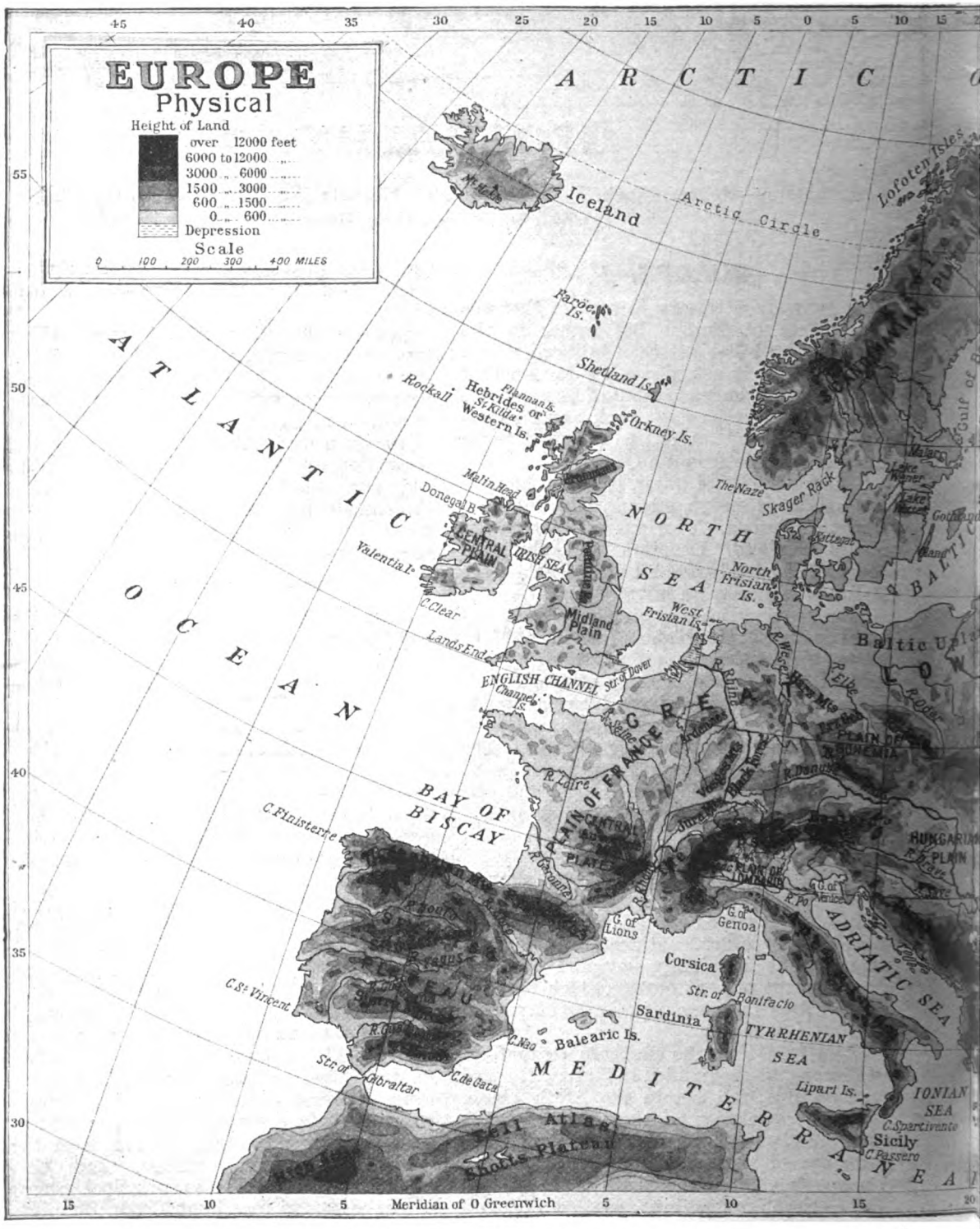
Physical Features

In order to take a rapid survey of the physical features of Europe we may begin with the mountains. The principal systems of the continent are the Iberian, Alpine, Scandinavian, Ural and Caucasus.

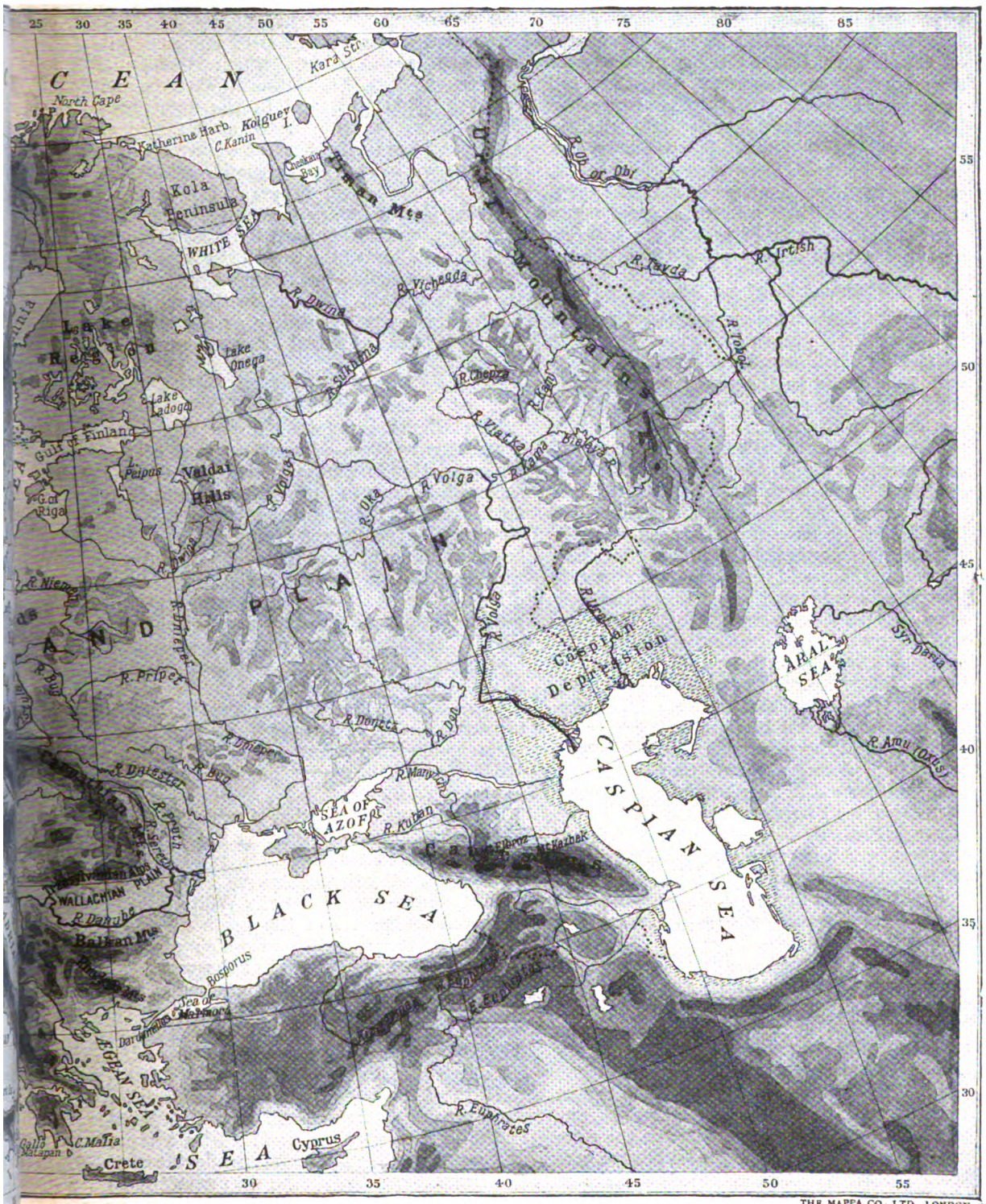
The mountain systems of Europe, however, are sometimes more arbitrarily divided into two main sections, the one of the north and the other of the south, which are separated by the Central Plain. These two systems are respectively the Scandinavian ranges, and the greater and loftier mountains of the south.

The Iberian system, of course, consists of the Spanish and Portuguese mountain ranges, and includes the Pyrenees, Toledo, Cantabrian, Nevada and Morena Mountains. The highest altitude here is 11,660 feet.

The Alpine system is the most important of southern Europe, covering an area of nearly 100,000 square miles, and culminating in an altitude of 15,781 feet. The main range of this rises in Switzerland, and from this region the spurs lead down in all directions, including the remoter ranges of the Apennines, Balkan, Pindus, and Carpathian Mountains. The principal passes of the Alps are the Mont Cenis, Simplon, St. Gothard, Semmering, Arlberg, St. Bernard, Splugen and Stelvio. The first five of these are tunnelled in order to permit railway communication.



Europe, which, with the exception of Australasia, is the smallest of the continents, ranks physically as an



extension of Asia. It has no peculiarly vast natural features, and its importance lies mainly in its inhabitants.

The Scandinavian mountains are those which run the entire length of Norway and Sweden, from the North Cape to the shores of the Skager Rack. Although the area they cover is an important one, they fall very much below the Alpine Range in height, the loftiest summit only slightly exceeding 8,500 feet. The indentations on the west coast of Norway are very marked, and the result of this is evident in the magnificent fjords that penetrate deeply into the land, the sheets of inland sea winding among the bold and striking mountains.

Great Central Plain

The Ural Mountains are somewhat notable from a political point of view, as they serve as the physical boundary between Europe and Asia, while to the south the Caucasus fulfils a similar purpose between the Black Sea and the Caspian.

The Great Central Plain of Europe comprises, very roughly, some two-thirds of the continent. Although some of its lesser areas are known under different names, it may be said to extend northwards from the Pyrenees across the northern half of France. After this the level low-lying country sweeps to the east and north-east, including Belgium, Holland, Denmark, North Germany and the greater part of Russia, while to the south-east of the continent, great areas of this plain extend as far as the Caspian Sea, the Caucasus mountains, and the Black Sea.

The greatest river in Europe is the Volga, which rises in the northern centre of Russia, and which flows east and then south for some two thousand four hundred miles until it empties itself by seventy mouths into the Caspian Sea. Although this river cannot compare in volume with the gigantic streams of the Americas, its importance may be judged from the fact that the distance in a straight line from its source to its mouth is no less than nine hundred miles.

The second European river in point of size is the Danube, which, including the windings of its various reaches, has a length of nearly 1,750 miles. The headstreams of the Danube rise in the Black Forest, and at Donaueschingen, where the confluence of these occurs, the Danube proper may be said to begin. The general trend of the stream is south-east, but as the river nears the Black Sea, it takes an abrupt turn to the north, and then swings almost at right-angles again to the east before emptying itself into the great inland sea. The commercial importance of the Danube is, of course, very great, as, among other things, it taps the extensive European granary of the south-east.

A third stream which is of immense importance is the Rhine, which rises in a glacier on Mont St. Gothard, at a height of over 7,500 feet, and in the first place flows down to the Lake of Constance. Emerging from this sheet of water, it flows westwards through Switzerland, and then turns to the north, in part of its course forming the boundary between France and Germany, and swinging to the west through Holland, it flows into the North Sea. The Rhine is navigable for steamers throughout its reaches below Basle in Switzerland, and is thus of enormous utility as a transport agent between Central Europe and the North Sea.

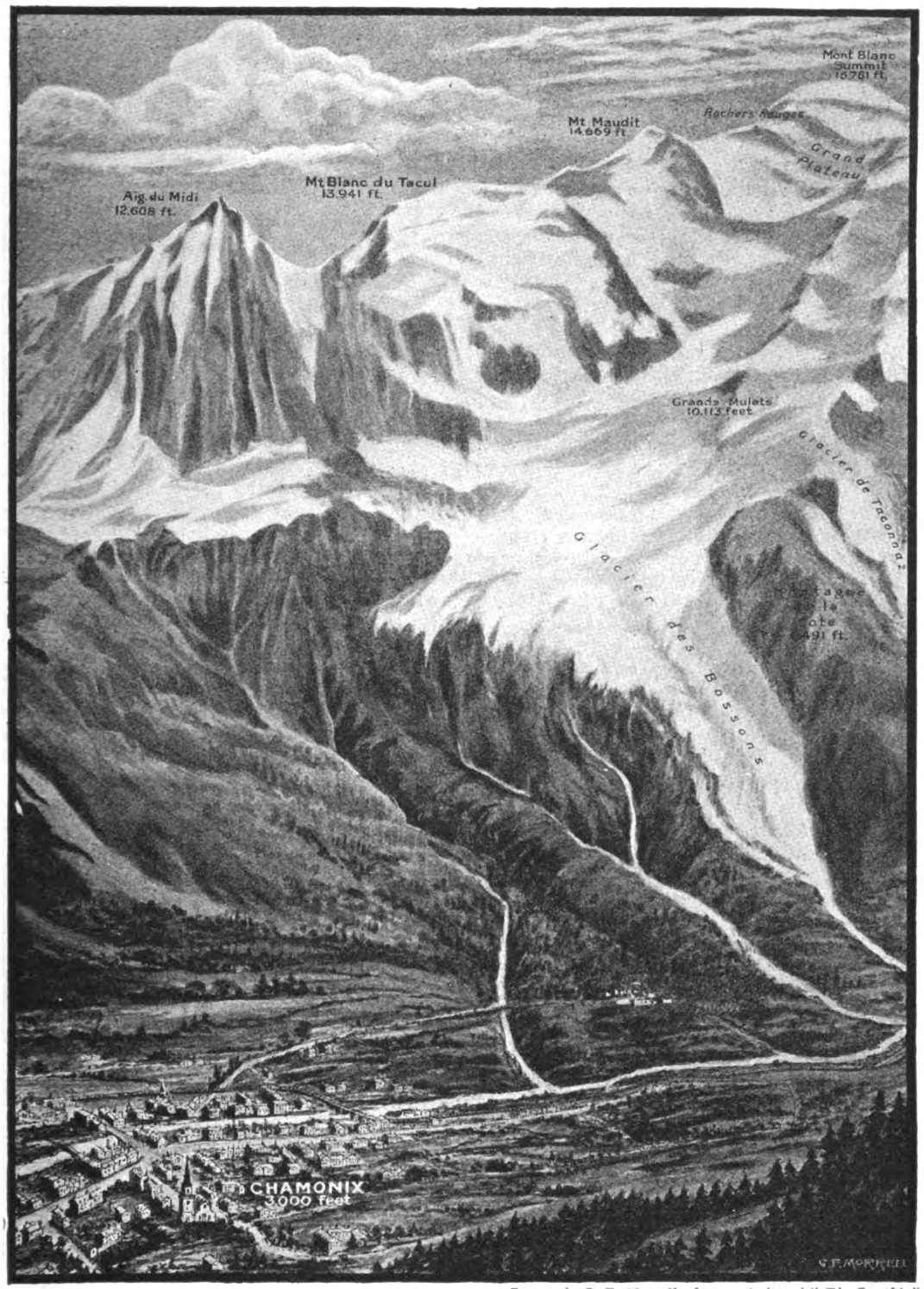
The Rhone Valley

The Rhone is another important river. Its source is quite adjacent to that of the Rhine in the St. Gothard Mountains. The stream first runs to the south-west and then to the north, flowing through the Lake of Geneva. On emerging from this at the town of Geneva, it is joined by the Arve, and here the curious spectacle is presented of the clear waters of the Rhone and the muddy current of the Arve running side by side without intermingling for a certain distance. Shortly after entering French soil the Rhone turns to the south, passes Lyons, and eventually flows into the Mediterranean inlet of the Gulf of Lions. It is navigable from Lyons to the sea, though shifting sandbanks occasionally render the navigation difficult.

There remain some other rivers of the first importance in Russia such as the Dnieper, which flows into the Black Sea, and the Don, which enters the Sea of Azov. The Dwina, which empties itself into the White Sea, is the most important of the northern rivers of Russia, the majority of which are ice-bound for the greater part of the year.

The lakes of Europe may be divided into two groups. The former of these comprise the large sheets of water in Russia, Finland and Sweden ; the latter is made up of the lakes in Switzerland and Italy. The characteristics of these two groups of lakes differ very much. Those of the north, situated in the lowlands, are surrounded by a tame and uninteresting landscape, while those of Switzerland and Italy, set in a mountainous and picturesque country, are noted beauty spots.

From the point of view of area, however, there is no comparison between the two,



Drawn by G. F. Morrell; by permission of "The Graphic."

"THE MONARCH OF EUROPE."

A striking representation of Mont Blanc and its neighbouring peaks, with Chamonix, the popular Swiss mountain resort, nestling in their midst.

Lake Ladoga, the largest of the northern sheets of water, having an area of 6,330 square miles, while Lake Geneva, the largest of the Swiss group, can boast of no more than 225 square miles.

Swedish and Swiss Lakes

The principal lakes of the north are the Russian waters of Lake Ladoga (which has already been referred to); Lake Onega, the area of which is rather more than half that of Ladoga, and Lake Peipus, which is 1,250 square miles in extent. In Lake Saima, Finland possesses about 2,000 square miles of water. The Swedish lakes of Wener and Wetter are considerably smaller, having an area respectively of 840 and 760 square miles.

Of the southern group the lakes of Lucerne, Zurich, Neuchatel, Thun and Brienz are situated entirely in Swiss soil. The southern shore of Lake Geneva, on the other hand, is that of Savoy, and the northern shore of Lake Constance, the second in point of size, is German. The Italian lakes which form part of this group are Garda, Maggiore (the northern waters of which are in Swiss territory), Como, and Lugano, a great part of which latter also washes Swiss soil.

The principal islands attached politically to Europe are, in the north, Great Britain and Ireland (which are the subject of a special article); Iceland, farther to the north, the northernmost points of which just fall within the Arctic Circle; the almost innumerable small islands which fringe the Norwegian coast and the west coast of Scotland, and the many groups in the Baltic Sea and the Gulf of Bothnia.

Mediterranean Islands

In the Mediterranean, proceeding from west to east, are the Balearic Isles, the largest of which is Majorca; Sardinia and Corsica to the east of these, and Sicily, separated from the toe of Italy by the Strait of Messina. Just to the south of this last is Malta, a British island of minor commercial value, but of great strategic importance, while to the east of this again is the Grecian Archipelago, with Crete situated to the south between Greece and Alexandria. This island, though not by reason of its size or population of great importance, is of the most intense historical interest. It is here that archæological discoveries have been made affording evidence of a high state of civilisation almost inconceivably remote in point of time. W.H.K.

Photo: D. McLeish.

THE LAKE OF GENEVA,

showing the Castle of Chillon, which Lord Byron has immortalised. The lake, though its area is only 225 square miles, is the largest of the Swiss group.

Continued from page 368.

BUSINESS AND COMMERCE:

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

CHOOSING A CAREER.—XXXIX

Bengal Pilot Service.—Appointments in this service prove attractive to boys who have received early training for the sea ; and preference is given to cadets from the training ships *Worcester* and *Conway*. The age limits are from 18 to 23 and application should be made in the first place to the *Secretary of State for India, Whitehall, London, S.W.*1. At least three years' sea experience is required before the candidate may apply for appointment ; and he should hold a Second Mate's Certificate.

Boilermakers are employed in all the large centres of engineering activity and form a separate trade by themselves. There is a period of apprenticeship, in some cases lasting as long as seven years, during which small wages are paid.

Bookbinders may be divided into two classes, those employed in factories and those establishing themselves as shopkeepers in suitable centres. In both cases there is a lengthy apprenticeship to be served, in some instances one of seven years. In this business there are numerous women employed ; and the better class work lends itself as an occupation for women of artistic gifts.

Booksellers may be divided into three main classes ; first, the tradesman who offers nothing but the latest new books ; second, the one who sells new works together with magazines, stationery and sundries ; and, third, the dealer in rare and second-hand books.

In either case, a sound, practical knowledge of the trade is essential, and no one should set up in business in either of these lines without having worked for some time as a paid assistant or active partner in a business.

In the case of the first section named, it is important that a good-class district should be selected and that the books offered should be such as to appeal to the people of the district.

The same remarks apply also to the second class, except that a knowledge of the newsagency and stationery trade is required. In this case it is usual for the shopkeeper to do business with a firm of wholesale newsagents from whom he can obtain not only his magazines, weeklies and newspapers but also stationery, diaries, notebooks and similar stock.

So far as the third class is concerned, a totally different knowledge is required. The worker in the world of rare and old books must have a soul for his stock and his knowledge must be almost endless.

Boot and Shoe Dealers.—Few businesses have been more affected by the multiple shop system than this, but there is still plenty of opportunity for those who establish individual businesses, provided the district selected is a suitable one. A fairly large capital is needed to start such a shop, for the stock must be both comprehensive and costly.

The usual plan adopted is for a boy to enter a boot factory at an early age under a system of apprenticeship so that he may thoroughly learn his trade. An alternative is for a shop boy to devote some part of his leisure to attendance at a technical school where boot making is taught. We may then imagine the shop boy becoming a shop assistant and eventually saving up sufficient capital either to buy a business or to found one for himself.

On the other hand, the boy apprentice at a factory might set up as a repairing bootmaker in a suitable neighbourhood and this is usually most profitable work. With care and economy the repairer might save sufficient to start a retail business, upon which he might build up a substantial connection.

Bottlemakers.—Glass bottles are made by blowing a mixture known as the " metal " into a mould and there are several centres of glass blowing in this country. Stourbridge is still an important depot for making bottles

and so is Leeds, whilst London also shares in the work of production.

Though the task has to be performed in an intense heat it is said that bottle makers enjoy the normal span of life and under present-day conditions the work is certainly not so unhealthy as it was some years ago. Boys who wish to become bottle makers should ascertain the names of the nearest firms from the Trade Directory in the free library. They should then write to one or more of these firms seeking apprenticeship, during which period they will be paid a small wage.

Brewers.—The brewing of beer is a highly technical task and a working knowledge of chemistry is essential. It is usual in order to become a brewer to be apprenticed to a firm of brewers for at least two years, the premium being from £150 to £250. Following upon the apprenticeship comes a period as improver, and most brewers in their tuition acquire practical knowledge at the various breweries where they may obtain employment, and theoretical training at technical classes.

Bricklayers. — In some parts of the country there is a system of apprenticeship for young bricklayers, but in other parts lads begin as labourers. There is a great art in becoming a master bricklayer, and the worker who will spare the time and effort for self-education in the reading of plans, the setting of the different bonds, the strains of brickwork, the types and points of bricks and general architectural matters may rise to be clerk of works or to occupy a similar well-paid post in the building world. A. C. M.

BOOK-KEEPING.—XXXIII

Income Tax, as its name denotes, is a deduction made from the income of persons chargeable. This deduction is of varying amount, according to the necessities of the State during any given year. Essentially a war tax, it has from time to time been increased. During the great European War it rose in 1918 to 6s. in the £ on unearned income. Certain abatements are allowed in respect of incomes of certain amounts. Incomes are arranged in classes according to source and returns are made under schedules. Five schedules for assessment purposes, lettered from A to E, are issued by the Income Tax authorities.

Schedule A is filled up by persons who derive their income from rent. The tax is levied on the tenant, who reimburses himself by deducting it from his next payment of rent. The tenant is assessed on the valuation of the property, less one-sixth, which is allowed as a deduction for repairs, in the cases of houses and buildings. It does not follow that the assessment will be less than the rent paid.

Schedule B is for income derived from the occupation of lands, i.e. farming, market gardening, and the like. The profits from each occupation may be assessed either under Schedule B as double the gross annual value given in Schedule A, or under Schedule D, which is based on the amount of profits from the business to be computed on an average of the three preceding years.

Schedule C is for the assessment of income derived from annuities and dividends from public funds. This tax is deducted at the source, i.e. before payment to the owner of the income.

Schedule D (*see above*).

Schedule E is for income derived from salaries, fees, etc., from public bodies and companies. The tax is based on the actual salary or emoluments of the year, and not on the three years' average.

Schedule D

From an accounting point of view the important features as to income tax will arise on Schedule D. In computing profits on which the average for the three years is to be taken, the ordinary Profit and Loss Account cannot be taken as the standard, as the net profit given by this account is generally something below the amount upon which the Income Tax Commissioners will assess the recipient of the income. Thus the following legitimate business deductions cannot be made for purposes of income tax.

(1) Interest on capital, or any annual interest, annuity or payment, payable out of profits, except interest on an overdraft at the Bank. Hence the duty on such annual payment should be deducted from the amount paid to the person to whom it is due before payment is made.

(2) Sums paid as salaries to partners, or partners' drawings.

(3) Sums expended in improving premises, or written off for depreciation of land, buildings or leases.

(4) Losses not connected with or arising out of trade.

(5) Expenses of maintenance of persons assessable, their families or private establishments.

(6) Losses recoverable under contracts of insurance or indemnity.

(7) Sums paid as income tax on profits or gains, or on the actual value of trade premises.

(8) Premiums for life insurance, or for wear and tear of machinery or plant.

Allowances may be made in this last case, and an agreed amount is generally deducted after arriving at the statutory income.

Difficulty sometimes arises in relation to chief rents and mortgages, but it is quite easy to see that these should not be allowed as charged in the Profit and Loss Account, because the amount of such income tax will have been deducted from the sums paid away as chief rent and interest on mortgage. The policy of the Government is to charge the tax on income at its source as far as possible. Hence dividends, debenture stock and such-like income is always received less income tax. In order to arrive at the amount of income chargeable, however, the tax should be added back.

The following deductions are allowed :—

(*a*) Debts proved to be bad.

(*b*) Rent of premises used solely for business purposes.

(*c*) A proportion of the rent of a dwelling-house used partly for business purposes, such not to exceed two-thirds of the rent.

(*d*) The annual value of any premises occupied by the owner solely for the purpose of business and not as a place of residence, according to the amount on which duty has already been paid under Schedule A.

(*e*) Not more than two-thirds the annual value, where the owner occupies the dwelling-house partly for business purposes.

In order that the deductions of amounts not allowed shall be more clearly understood, the following exercise might be considered. There are two methods of presenting the amount of the return for Schedule D for purposes of Income Tax, the first method being to redraft the Profit and Loss Account, omitting such items of debit as are not allowed, the second being to take the net profit as given in the ordinary Profit and Loss Account and add back such items as are not allowed.

EXAMPLE :

The understated Profit and Loss Account is that of Foley Hobbs. You are asked to redraft this Account in accordance with the requirements of the Income Tax authorities (for the purpose of arriving at his liability for Tax under Schedule D).

PROFIT AND LOSS ACCOUNT

	£	s.	d.		£	s.	d.
To Ground Rent	25	–	–	By Gross Profit	1,564	–	
,, Rates	94	–	–	,, Dividends received, less Tax	119	–	–
,, Income Tax :—				,, Discount Account ..	52	–	–
Sch. A .. £18 – –							
Sch. D. .. 98 – –							
	116	–	–				
,, Travelling	140	–	–				
,, Interest on Capital ..	250	–	–				
,, Interest on Bank Overdraft	24	–	–				
,, Depreciation :—							
Lease	100	–	–				
Plant (10%)	52	–	–				
Furniture and Fittings (10 %)	10	–	–				
,, Interest on Mortgage ..	40	–	–				
,, Bad Debts	98	–	–				
,, Net Profit	786	–	–				
	£1,735	–	–		£1,735	–	–

Foley Hobbs possesses the lease of the works he occupies, the Schedule A assessment of which is £300. The premises are mortgaged for £1,000 at 4 per cent.

(Royal Society of Arts.)

PROFIT AND LOSS ACCOUNT
FOR INCOME TAX ASSESSMENT

	£	s.	d.		£	s.	d.
To Rates	94	–	–	By Gross Profit ..	1,564	–	–
,, Travelling	140	–	–	,, Discount A/c. ..	52	–	–
,, Interest on Bank Overdraft	24	–	–				
,, Bad Debts	98	–	–				
,, Profit for Tax purposes ..	1,260	.	–				
	£1,616	–	–		£1,616	–	–

The amount £1,260 is averaged with the profits of the two preceding years after the deduction of £300, Schedule A. An agreed figure is then deducted for wear and tear. Depreciation for general accounting is very different from depreciation for Income Tax purposes. The amount allowed off Plant depends on the nature of the plant. Furniture would not be allowed to be depreciated to the extent of 10 per cent. and the deduction on the lease would be disallowed.

Thus profit for tax = £1,260
Less Sch. A. .. 300

£960 averaged with previous two years, say £850
Less allowance for wear and tear as agreed with Surveyor .. say 48

£802

Of course the exercise finishes at £960 with an explanatory note regarding depreciation ; averaging and deducting agreed amount for depreciation are additional steps.

Definitions of Terms

An Adjustment Account for Income Tax purposes is an account adjusting the Profit and Loss Account in order that it shall satisfy the Income Tax Commissioners for the purposes of assessment.

Super Tax.—This is a tax in addition to the ordinary Income Tax. At the present time the amount which is allowed as an abatement from total income before the charging of Super Tax is £2,000.

Depreciation for Income Tax Purposes.—Most properly managed enterprises depreciate plant, machinery, fittings and furniture to a generous extent, the amounts charged to Profit and Loss ranging from 5 per cent. to 25 per cent. according to the nature of the property depreciated. Similarly leases which are deteriorating property are often written off. Income Tax authorities, however, will not allow the amounts considered judicious by the business man himself. No amount may be deducted for decreasing value of a lease, but the Surveyor will agree an amount for depreciating value of plant, machinery, and the like.

Exemption from Income Tax.—Where the income of a person from all sources does not exceed £130, he is exempt from payment of Tax. An abatement is allowed from incomes between £130 and £700 per annum : e.g. from £130 to £400 the abatement is £120. A limited company cannot claim such an abatement.

Life assurance premiums not exceeding one-sixth the total income and limited to 7 per cent. of the sum assured at death are allowed as an exemption where the annual income does not exceed £800. Persons in receipt of incomes below the amount mentioned are also entitled to allowances amounting to £50 in respect of a wife, £40 in respect of the first child, and £25 for each additional child under the age of 16 years. The age limit is extended where it can be shown that a child is receiving full-time instruction in a school, College or University. An abatement is allowed in respect of children when the statutory income exceeds £800, but does not exceed £1,000, but in this case the abatement is in respect of each child above the number of two. Such allowances are made from earned income as far as this is available.

Work the following Exercise :—

Exercise

The Profit and Loss Accounts, as prepared by Robert Rayleigh, for the three years ended March 31, 1913, are set out below.

The factory occupied by him was his own freehold property, the Schedule A Assessment being £300 per annum. The Surveyor disallowed the amounts charged in the Accounts for Depreciation, but agreed to an allowance of £39 for Depreciation on Plant.

Prepare R. Rayleigh's return for Schedule D purposes for the fiscal year 1913-14.

KEY.—Income, 1911 = £868. 1912 = £409. 1913 = £338.

Statutory Average Income, £538 6 8.
Net Statutory Average Income, £499 6 8. F. H.

PROFIT AND LOSS ACCOUNTS

	1911	1912	1913		1911	1912	1913
	£	£	£		£	£	£
General Expenses ..	450	501	462	Balance from Trading Acct. ..	2,190	1,842	1,692
Depreciation (Plant) ..	82	71	68				
Do. (Fixtures) ..	15	15	15				
Fire Insurance ..	12	12	12				
Income Tax	29	27	19				
Interest on Capital ..	350	350	350				
Charitable Donations	10	19	17				
Salaries	560	620	580				
Net Profit	682	227	169				
	£2,190	£1,842	£1,692		£2,190	£1,842	£1,692

Continued from page 377.

ENGLISH LANGUAGE AND LITERATURE:

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POLITICAL ECONOMY.—II

In any study it is essential to know exactly what we mean by the terms which we constantly employ. Political economy is at the disadvantage that the terms used have a popular sense as well as the stricter and more scientific sense in which they are used by the economist.

Some writers appear to disregard this fact, and proceed to use the terms as if their limited and strict scientific significance was thoroughly understood by all. We shall, however, endeavour to give exact definitions of all, or nearly all, the economic terms as they occur.

What is Wealth?

As we have already seen, wealth was for a long period regarded as money, until Adam Smith pointed out the fallacy and told us that "wealth consists of any commodity with an exchangeable value." Yet we find Mill, in his preliminary remarks in the *Principles of Political Economy*, stating that "everyone has a notion sufficiently correct for common purposes of what is meant by wealth."

Ruskin, in his preface to his essays in Economics, *Unto this Last*, clearly points out the impossibility of proceeding to the study of this or any other scientific subjects without a physical nicety and logical accuracy in definition.

Wealth may be logically and accurately defined as "all and only such subjects as have *utility* and can be *appropriated in exclusive possession*, and therefore can either be exchanged or have an exchange value."

The essentials are (1) Utility; (2) Exclusive possession; (3) Capability of exchange or with an exchange value.

The air we breathe is of the greatest utility; it is not only a want but a necessity of life, and yet it is only wealth in the economic sense under certain circumstances because its supply is unlimited and is not generally taken into exclusive possession, and by reason of its abundance it has no exchange value.

Is Skill Wealth?

The same thing may be said of water. Water can be obtained in unlimited quantities, but not in the same way as air; it is not universal; that is, it cannot be obtained anywhere and everywhere. It is conveyed not only by its natural source but often by an artificial source, and stored to make it available for the population of the large towns and cities, and thus it acquires two of the attributes mentioned in the definition —possession, and it has acquired an exchange value.

In mid ocean, water (i.e. salt water) is not wealth; it is there in abundance; but in a town a few miles inland sea water conveyed there by artificial means would be wealth.

It is difficult to draw a definite line and say what is wealth and what is not wealth, as we have seen by the two illustrations which have been given. If a student had been asked by one of the old economists if air and water were wealth and had given his answer in the affirmative, he would have been told that he was wrong. Yet both are under certain circumstances *wealth*, viz. air will be wealth when it is compressed; water when it is collected for either domestic or commercial use.

The character of wealth may be given to a commodity by the shifting caprice or by the changing wants of man and by the advance of science. It thus becomes evident that exchange value is the principal charac-

teristic which stamps a commodity with the essential attributes of wealth.

Economists are not agreed whether personal qualities should be included as wealth. The skill of the surgeon, the ability of the artist, the acumen of the statesman and lawyer, the learning of the professor and divines, the gifted author, as well as the strength of the workman. Their skill and ability are in their exclusive possession, and are of exchange value, that is, their abilities are all marketable commodities; as de Quincey points out in his *Logic and Political Economy*, professors were to be purchased in the Roman markets.

"Living Capital"

Professor Nicholson, however, holds the opinion that personal qualities should not be regarded as wealth. They are recurring and partake more of the quality of capital, and he calls them "living capital," and estimates its value in the United Kingdom as £47,000,000,000. Although other economists have not directly accepted Professor Nicholson's contentions, no statistician has ever included the value of personal qualities in their estimates of the national wealth.

The student's attention having been drawn to the question, we shall look upon personal ability and embodied utilities as the "living capital" of the nation, and confine our definition to the material commodities which are capable of utility with exclusive possession and of exchange value.

Some economists assert that labour is the source of all wealth, that natural resources do not represent wealth until labour has been applied to them, that wealth is only crystallised labour. It is true that labour is essential to the production of wealth, but not all wealth.

It cannot be said that there is no commodity which is in exclusive possession, and which does not possess an exchange value until labour has been applied to it. There are "rights" which contain all the attributes of wealth.

There is the hidden coal and mineral wealth. This has not been produced by labour; it is in the exclusive possession of the owner of the mineral rights, and is constantly exchanged for value by the owner selling his rights to a person or company who is prepared to work the mines.

In the loosest language we talk of producing the coal. Labour does not produce the coal. Labour in this case is applied to natural wealth which already exists and increases that wealth, by rendering it capable of being distributed to administer to the wants and requirements of a nation. Labour neither produces the coal nor does it give to the coal the other attribute of wealth—exchange value; it can only be said to have added to the exchange value.

What do we mean by labour? If you accept the definition of the revolutionary school of socialists you would confine labour to manual labour, but this definition would obviously be far too limited. We can define it as "man's effort applied to production" or "human action productive of values." This definition includes not only the muscular force, but the skill which directs that force.

Schrijvers, in his *Handbook to Political Economy*, says: "One universal economic fact is the division of labour into invention, direction and execution. This division is based on man's very nature."

Production has two requisites—labour in all its forms and appropriate natural agents or natural wealth on which to exercise its functions.

Agents of Production

The earliest forms of wealth were probably implements for hunting and fishing, and personal ornaments, clothing and huts. Then came domestication of animals and, as population increased, it became necessary to cultivate the land, and we find the early inhabitants settling down to agriculture, and from this fact we find some economists stating that the soil is the only source of wealth. Here again we find a limited application of the term which cannot be sustained.

By the soil we mean the subsoil which is natural wealth, something which by custom was retained in possession and acquired an exchange value, and which by the application of labour became more productive, and wealth was increased. Therefore we must regard wealth as composed of its various elements, natural resources or natural wealth, which is increased when labour is applied.

Mill describes the services which labour renders to the production of wealth as "putting things into fit places" or "moving one thing from or to another." This definition is so comprehensive as to include all the varied operations of industry. "Labour, then, in the physical world is always and solely employed in putting objects in motion; the properties of matter, the laws of nature do the rest."

Or we may say that labour in itself is impotent, natural wealth is useless, and

it is only by the application of the human forces to natural products that wealth is produced in such a form as to render it of greater exchangeable value by being made available for distribution and consumption. It must not, however, be imagined that natural resources and labour are the only factors which enter into production.

Labour requires supporting during its operations, and it finds that support in Capital, which plays an important part: it not only maintains labour, but also provides machinery.

Capital and its functions will be dealt with fully in a subsequent chapter.

As we have already seen, one of the essential elements in the definition of wealth is *utility*. The production of wealth must be regulated to the supply of such commodities as are of use to mankind, and in this respect the word *use* cannot be confined to its narrow meaning denoting things that are absolute necessities.

Professor Marshall says: " Man has always been developing new wants and new and more expensive ways of gratifying them." Therefore the term " utility " must be taken as embracing not only such things as are necessary, but also such things as satisfy the wants and desires of mankind.

Demand and Supply

Works of art, beautiful flowers, palatial residences and a hundred and one other things which could be mentioned, while they tend to satisfy the wants or desires of one class of the community, would not be deemed to come within the strict definition of *utility*, but they are all included in the economic definition of the term.

While there is a demand for a commodity, even though that commodity is not a necessity but a luxury, there will be a supply, therefore production is regulated to a very large extent by demand. Demand, on the other hand, is stimulated by the foresight of those who direct and control production.

We have already dealt with two agents in the production of wealth, i.e. natural resources, which include land, and minerals which are natural wealth, and labour in all its forms applied to these resources; but these have to be aided, as we have seen, by a third agent, capital.

Now the owners of these different agents in production are under the system of society entitled to a share of the wealth produced. Whether the shares which they now receive are equitable, is not within the scope of the present article.

The owner of the land and minerals is called the landlord, and he receives for the use of his land a reward which we call " rent," but the land may have buildings on it, and in this case the rent includes the use of such buildings, so that rent is not paid for natural resources, but for wealth which has been added to the element provided by nature.

The person who provides the capital to support labour during production is known as the *capitalist*, and the share he takes is called *interest* or, as some would say, the *rent* for his money.

Labour, as all will agree, is essential; both natural resources and capital being impotent until labour is applied. Therefore labour is not only entitled but justified in insisting on its share of the wealth produced, and securing the best return in what we know by the term *wages*.

Property Rights

We will try to ascertain now what are the rights affecting what is commonly called ownership of land and how these rights were originally acquired.

Rights are of two kinds and are known in Law as *Jus in rem* and *Jus in personam* and are survivals of the Roman law. They were not, however, terms devised by the old Roman lawyers but by the civilians.

Jus in rem means rights which avail against persons generally, and *Jus in personam* means rights against certain or determinate persons. Thus what we call the ownership of property is a *jus in rem*. It is a right which resides in a person over or to a person or thing and availing against other persons universal or general.

" *Jus in personam* means rights which are available exclusively against certain or determinate persons." (Austin's *Jurisprudence*.) Thus a person who holds a contract or agreement binding a specific person to do or refrain from doing a certain thing would be said to have a right in personal.

The title to land, or property as it is often called, includes the two rights which have just been explained.

There is nothing which so generally strikes the imagination and engages the affections of mankind as the rights of property. Yet how many give themselves the trouble to consider its origin and foundation, unless they are compelled to do so when qualifying for the legal profession.

They think it is sufficient to know that land or property passes from one person to another either by sale or by succession.

In the beginning of the world we are informed by Holy Writ, the all bountiful Creator gave man "dominion over all the earth and over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth."

The earth, therefore, and all things therein were the common property of mankind, the immediate gift of the Creator. While the earth was sparsely inhabited this system was all very well, but directly the population increased a system of society and economic conditions grafted themselves on the communal system. It was found necessary to entertain conceptions of more permanent dominion and to appropriate to individuals not the immediate use only but the very substance of the thing to be used.

Man was thereby encouraged to cultivate the soil, to provide himself with a habitation for shelter and safety and raiment for warmth and decency. No man would have been at the trouble to provide either, so long as he had only a temporary enjoyment of them.

Ownership of Land

Occupancy by universal agreement gave the right to the temporary use of the soil, and gradually it became a recognised custom that occupancy gave man in particular and not generally, an exclusive right to permanent property in the substance of the earth itself and a right to retain in a permanent manner that specific land which before belonged generally to everybody, but particularly to nobody, and to exclude everyone else from the use of it.

The right of property in land was no legal fiction, it was a right which was granted by common consent, and after centuries of use the custom became the law of the land.

Whether the system of what is called private ownership is the best system in the interest of the community is no part of our duty to decide. We have to deal with the facts as they are. Private ownership was established centuries before the Norman Conquest, and we have to accept it as the economic basis.

When the owner or, to speak more correctly, the holder of land parts with possession for a period to another person he does so for a consideration which is called *Rent*.

Rent may be defined as "the share of wealth which is claimed by the owners of land, it is the price which is paid to them for the use of their land." Land, as we have seen, is a source of wealth, and the rights in land embody all the elements of wealth, therefore it follows that the owner of land or the owner of one of the agents of production is entitled to a share in the distribution of wealth.

The share of wealth to be taken by the owner of the land as Rent differs. It is governed by a variety of causes; for agricultural purposes fertility of the soil and situation are important factors. Land rich in minerals, although not fertile, will command different considerations, and land for building purposes will be considered from another set of conditions.

In each case competition will increase or diminish the price to be paid, which becomes a matter of a bargain between the landlord and the tenant just as there is between the buyer and seller of any other commodity.

J. W. U.

PHILOSOPHY.—XI

A QUESTION of prime importance is that which Kant asserted to be one of the fundamental problems of philosophy: What *can* I know? Obviously related to this problem are the questions: What *do* I know? What is knowledge? How does it differ from belief or mere opinion? And again: How is knowledge obtained?

That knowledge is, if not the most important, at least one of the most important keys of the gate leading to individual and social welfare, is a truth recognised by all thinking men; and it is no less true that the pursuit of knowledge "for its own sake" often leads in a remarkable manner to knowledge that is directly applicable to the more practical needs of man.

Empiricism *versus* Rationalism

How is knowledge obtained? For many, many years there raged a controversy between two schools of thought, known as the "Empirical" and the "Rational," as to whether all knowledge was the product of experience—i.e. given in sensation through the bodily organs of sight, touch, hearing, etc.—or whether we have some ideas which are "innate"—i.e. which are independent of sensation. This question is now of much less interest than formerly, and it is generally accepted that there is no knowledge without sensation; and even that kind of knowledge which has a greater degree of certainty than any experience could give it (e.g. that $2 + 2 = 4$) would be non-existent but for the activities of our sense organs. Interest

has rather been deflected in the directions of investigating the superior certainty of such truths, and of determining the relative shares taken by reason and sense-experience in their elaboration.

The mental faculties which are pre-eminently concerned in cognition (the acquisition of knowledge) are observation (sensation) and the logical faculty of reasoning: whether it is possible that the knowledge may accrue through any other faculty—e.g. the emotions—is extremely doubtful. When we isolate *in thought* certain faculties or powers of the human mind, we do so because it facilitates investigation; and we must not lose sight of the fact that the conception of consciousness as a whole, as a unity, is also a weapon of great practical utility in the investigation of mental phenomena; and further that the different faculties are closely connected with each other.

Emotions and Will

The intrusion of the emotions and the will into the process of cognition is a fact of considerable importance, sometimes baneful, sometimes beneficial. The greatest infirmity of the human mind, said Pasteur, is to believe what we *wish* to be true. On the other hand, the non-intellectual faculties have played, and continue to play, a notable, if subsidiary, part in the development of the natural sciences.

As Professor T. P. Nunn has demonstrated, the developmental process consists of three fairly distinct stages. In the earliest, feelings of wonder and curiosity supply the motive power which puts the intellectual machinery in motion. In the second stage, these feelings cease to predominate; reason in her two-fold garb of induction and deduction asserts her sway, and the will is concentrated on the attempt to subdue and control the forces of nature in the service of man. In the last phase, intellect, will, and emotions co-operate to produce the disinterested passion which seeks to "organise" the knowledge gained in the two earlier stages by regarding its data from a common point of view—e.g. by subsuming them under a general concept like that of energy (Vol. V., p. 185).

What do I know? What certain knowledge do I possess? The answer which Descartes gave to this question is already familiar. *Cogito ergo sum*, I think therefore I am. If under "I think," we also include "I feel" and "I desire," there is little to be said against the proposition. Nevertheless, it contains one element of uncertainty, viz. the *I*. Eliminating all hypothesis and inference, the rock-bottom fact is the existence of a "stream of consciousness," a number of sensations, feelings, thoughts, and desires, which succeed, and may also accompany, one another in time. This is probably what Bergson means when he says, life is a flowing; it is a hypothesis, at least, which helps us to understand such phenomena.

To this underlying mental entity, such names as the ego, the soul, the subject, the self, the self-consciousness, are given: but if we would divest our deliberations of the hypothetical, we must substitute some such phrase as "a series of conscious states" or "a group of mental phenomena," etc. In any case, we may take it that our own mental phenomena constitute the most certain knowledge.

The next step is to consider whether anything exists which is not part of our mentality—anything "extra-mental." Common sense undoubtedly affirms that there is an external world and that it contains innumerable objects, such as stones, water, air and other gases; and to these physical science adds a number of other entities—e.g. electrons, atoms, molecules, and energy.

Have we really knowledge of this world, or is it only dream or hallucination? If we have such knowledge, what degree of certainty has it? For a clear statement of the questions of the nature and validity of our knowledge, the student is referred to *The Problems of Philosophy*, by the Hon. Bertrand Russell, a book to which the writer is indebted for many of the remarks made in this lesson.

The Validity of Knowledge

Before attempting any answers to these questions, it will be advisable to discuss different kinds of knowledge with special reference to their validity. I wake up in the morning and see a picture on the wall. The sensation of light gives me immediate knowledge of the picture: such knowledge is of a high order of certainty, and is what is called a sense datum, knowledge derived directly from sensation.

Again, I am awakened by a shrill sound, and I say at once that it is the sound of a passing train. The knowledge that the sound is due to a train is not quite so immediate as that of the picture on the wall: it is obtained by "association," or psychological inference. Experience has taught me that the particular sound is made by a passing train, and when I hear the same

sound the thought of the train is immediately evoked in my mind.

Further, I may be fully conscious that I am looking at the picture—this is knowledge of a mental state. These three instances are examples of immediate or direct knowledge, and except for the circumstance that appearances do deceive sometimes, and people occasionally suffer from illusions and hallucinations, we should say it was quite certain.

I walk down town in the spring, and a street vendor offers me a buttonhole of primroses. I note, too, that many passers-by are wearing them. Oh! I say, it is Primrose Day, and I state it as a fact to other people that I meet. The knowledge that it is Primrose Day is not direct, but inferred from my observations. Such a conviction is derived or inferred from sense data.

Sense Data

It will be obvious that the inferred knowledge of the last case is less certain than the immediate knowledge of the first three cases. Since sense data are not all equally certain, and most contain some element derived by association or inference, we shall use this term to connote any knowledge that immediately follows from sensation, together with any immediately derived from it by association or by logical inference. Belonging to the order "sense data" must also be included our immediate knowledge of relationships between them—e.g. this stone is harder than that; this note on the violin is the same as that on the piano; this biscuit has the same taste as that bun, *et hoc genus omne*. Speaking generally, we may say that the more closely related knowledge is to sense, the more certain it is; but when we leave the immediate data of sense there are many degrees of certainty ranging from the degree of very high probability to that of very remote possibility.

Further, when we talk of possibility, it is important to distinguish between that which is conceptually possible—i.e. can be imagined—and that which is experientially possible (is a possible sense datum). Thus, I can well *conceive* of the existence of a centaur or of a mermaid, but all my past experience tells me that the belief of expectation, that I shall ever see either, is entirely unjustifiable.

More certain, however, than any sense data are various mathematical and logical truths. As we have already remarked, these truths are not independent of sense-experience, but they have a certainty, a validity, which no amount of experience could bestow upon them. For example, we cannot imagine that two added to two would ever make more or less than four things, or that any plane triangle could exist of which the three angles were not together equal to two right angles.

And it is even so with the self-evident truths of formal logic, e.g. the principle or law of contradiction, that two contradictory statements cannot both be true, and the statement that an inference from a true premiss is itself true. The term "intuitive" is often applied to obvious truths which are incapable of proof.

The gradations between certain knowledge and remote possibility are almost innumerable. In practical life, ability to estimate with even rough accuracy the validity of reported statements can scarcely be overrated, and this power vies in importance with our capacity to appraise the values, from a human standpoint, of items of knowledge. We decry rightfully the superstitions of bygone ages; with equal rectitude we regard as foolish those who tread the sterile paths of unceasing doubt. The *via media* is the route to be followed; a healthy scepticism and intelligent belief are both requisite for the pursuit of truth and for the regulation of conduct. Moreover, the great edifices of human endeavour—sciences, arts, and philosophies—contain hypothetical elements which are beyond our power of proof.

Summary

The investigation of the nature, validity, and possibility of knowledge is of fundamental importance to philosophy and to human life.

The dispute between Empiricism and Rationalism concerning the origin of knowledge is practically dead. It is now usually admitted that sense experience is a *sine qua non* of all knowledge.

Cognition is a mental process intimately connected with sensation and reason. Other mental faculties—e.g. the will and the emotions—influence it, and this participation is well shown in the development of the physical sciences.

The fundamental certainty is the existence of our own mental states. The postulate that there is an Ego is less certain, but useful.

Colours, sounds, smells, tastes, etc., are called sense data; the state of being aware of them is called sensation.

Sense data and the immediate knowledge of relationships between them have a high degree of certainty. Knowledge derived by logical inference is less certain. There are very many and often scarcely perceptible gradations between certainty and possibility.

Mathematical and certain logical truths have the highest degree of certainty. E. H. T.

Continued from page 384.

HISTORY:

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THE FRENCH REVOLUTION

By 1788 the financial straits of France had become desperate. The Ministers who succeeded Necker proved totally incapable of grappling with the situation. As a last resort, the Government was compelled to recall him, and summon the States-General.

This was the beginning of the end.

The States-General met in May, 1789, for the first time since 1614. The clergy numbered 291 members, the nobles 270, the Third Estate (to whom double representation was granted) 584. The first question concerned the voting of the Orders. The King and the Court desired their votes to be recorded separately, thus depriving the lowest Order of their numerical advantage.

The temper of the Third Estate was indicated in a pamphlet by the Abbé Sieyes —" What is the Third Estate ? Everything ! What has it been until now in the political Order ? Nothing ! What does it ask ? To be something ! "

Fall of the Bastille

When the nobles and clergy refused to join them their deputies resolved themselves into a National Assembly and took the celebrated Oath of the Tennis Court not to separate until they had established a Constitution. The majority of the clergy and some nobles seceded, and finally, on Necker's advice, the fusion of the Orders was agreed to.

The Court, in alarm, dismissed Necker and concentrated a large force of troops, including many foreign regiments, in the neighbourhood of Paris. Discontent rose to fever-heat and was fanned by the King's brother, the Duke of Orleans, who hoped to supplant him.

Arms were seized, the Bastille was attacked. Its weak garrison surrendered on promise of life, but the Governor and several others were murdered. The horrors of the Bastille are largely legendary, but its fall was an event of the first importance. It marked the beginning of mob-law in Paris.

The Parisians now formed a National Guard of 48,000 men under the Marquis de la Fayette, a Liberal noble, who had served in America. Meanwhile the whole machine of Government had broken down.

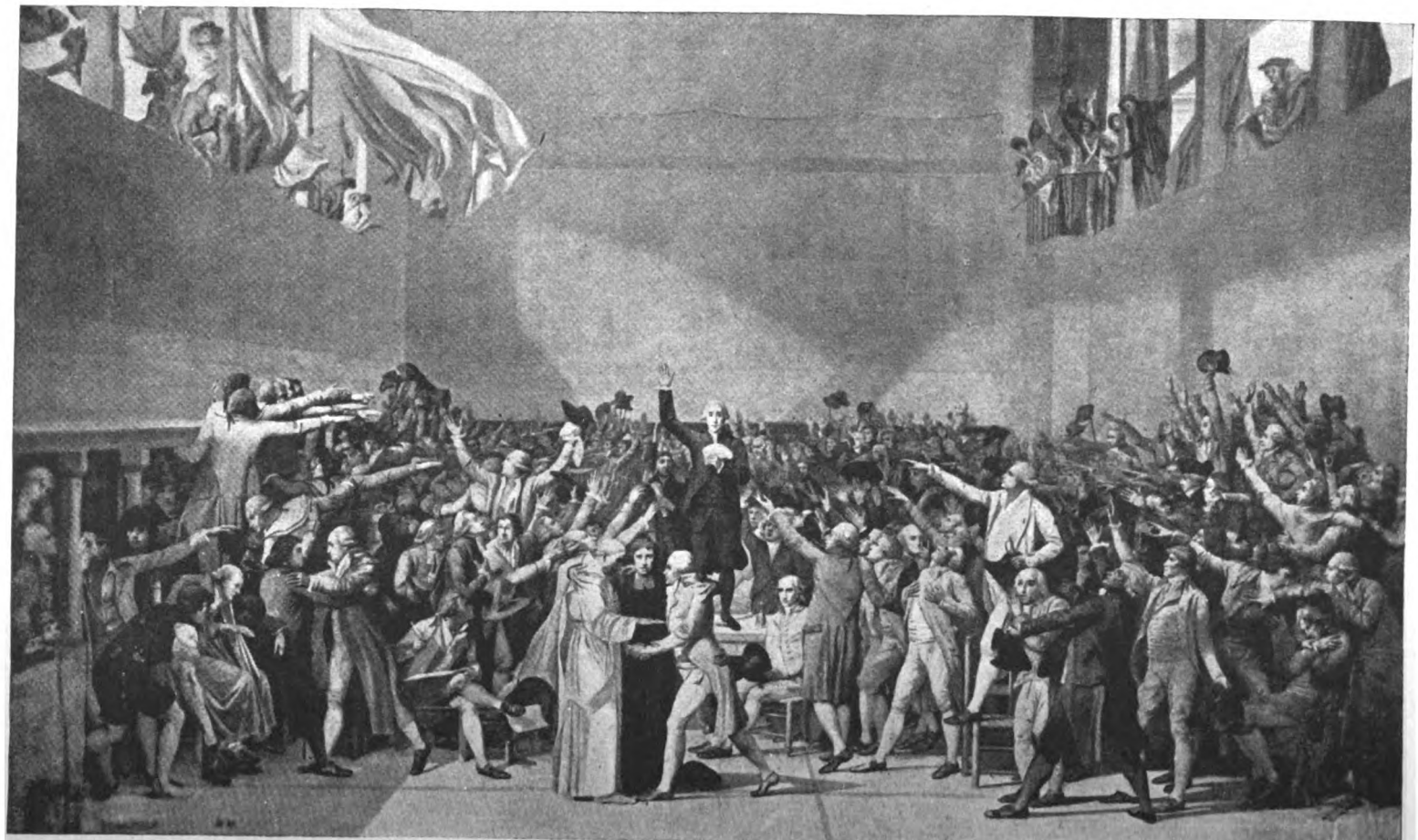
While " spontaneous anarchy," to use the words of Taine, was breaking out all over France, the National Assembly was receiving deputations, discussing abstract principles and drawing up a " Declaration of the Rights of Man."

The King and Mirabeau

On August 4 the nobles and clergy renounced their privileges. Many of them were moved by the sincerest patriotism, but reforms so sweeping cannot safely be carried out in haste. Mirabeau (son of the Economist), the one practical statesman in the house, strove hard for a reconciliation between the King and the people which should render it possible to unite free institutions with a strong executive. But he was hated by the King for his vices ; whilst the nobles despised him as a demagogue, and the commons distrusted him as a noble.

The party, which desired a constitution on the English model, was opposed both by the more Conservative nobles and by the rights-of-man idealists, who had learned politics from Rousseau. The King, too good-natured for a despot, too dull for a reformer, could take no decided line, and gave no lead to the nation.

A Royalist banquet on October 1 was magnified by rumour into a military plot. Food at the time was scarce owing to the prevailing anarchy, and on October 5 a body of women, followed by large numbers of men, proceeded to Versailles, where the King received a deputation. La Fayette and the National Guard proved unable to control them, two Guards were murdered and the



From the painting by Jacques Louis David.

THE POPULAR DEMAND FOR REFORM.

In May, 1789, the States-General met for the first time since 1614. The Clergy and the Nobles refused to associate themselves with the drastic measure advocated by the Third Estate. The latter, therefore, on May 20, at the celebrated meeting in the Tennis Court, took the oath not to separate until they had established a Constitution.

Queen barely escaped. The next day they compelled the Royal Family to return with them to Paris.

On July 14, 1790, a great "Feast of the Federation" was given by Parisians in the Champs de Mars to the deputies of the Army and the departments. The King himself attended and swore faith to the Constitution; this aroused universal optimism. None the less, the catastrophe was very near at hand.

It was brought nearer by the treatment of the Church. In 1789 the property of the clergy had been confiscated, provision being made for their maintenance. In July, 1791, a new Civil Constitution was forced on the Church, providing for popular election of Bishops and *curés* and strict control of all clergy by the civil power.

A large proportion, including 128 prelates, were deprived for refusing to take the oaths, and the feelings of the majority of devout Catholics were outraged. The King, whose consent was extorted by severe pressure, was deeply moved and, largely at the instigation of the Queen, began to meditate an appeal to foreign powers.

The Flight to Varennes

On June 20, the King and Queen attempted to leave the country. Their escape, however, was mismanaged; they were recognised at Varennes and turned back. The Assembly declared the King suspended from his office; the Club of Cordeliers, a group of extremists headed by Danton, clamoured for his deposition and trial. The Assembly, however, was not prepared to go to this length. On September 13 the Constitution was finally voted, and on the 14th the King swore to observe it and was reinstated in his powers.

The Constitution began by confirming the reforms already effected. It went on to establish government by a Single Chamber, to be elected every two years by indirect vote. Ministers were exeluded from sitting as deputies and the King could neither prorogue nor dissolve the Chamber.

While many of the civil reforms were admirable and lasting, the political system, with its excessive decentralisation of authority and subordination of the Executive to the legislature, was weak and unworkable. Mirabeau had striven vainly against the exclusion of Ministers from the Assembly.

The first Legislative Assembly under the new Constitution met in October, 1791. By a mistaken self-denying ordinance the Constituent Assembly, on the motion of Robespierre, had forbidden the re-election of its members. The Assembly was again to be composed of men without political experience.

The Legislative Assembly began by confiscating the property of the *émigrés* and depriving the non-juring priests. The King opposed his veto, thus drawing down hostility upon himself.

The attitude of Austria had become threatening and the most active party in the Assembly, led by a Norman journalist, Brissot, conceived the idea of forcing the King into a war which he would detest, as a preliminary to his overthrow. La Fayette and the Moderates also desired war in the hope that a victorious campaign would rally France round the new *régime*. Danton and the extremists opposed it for the same reason.

Storming the Tuileries

On April 20, 1792, war was declared against Austria. The Brissotin Ministry fell and La Fayette and his friends were placed in power. The Brissotins, in revenge, co-operated with the extremists, and on June 20 the mob forced their way into the Tuileries, insulted the King, who behaved with calm courage, and forced him to adopt the red cap of liberty. A contemplated *coup d'état* of the Moderates was wrecked by the Queen's mistrust, and La Fayette had to leave Paris. A foolish manifesto threatening vengeance upon Paris, which the Duke of Brunswick, who led the invaders, issued at the instance of the *émigrés*, aroused strong national feeling.

On August 10 the storm broke.

The Tuileries were stormed. The Swiss Guards, who defended them, were massacred; the King and his family took refuge at the Assembly. La Fayette fled the country; whilst the King was suspended from power and imprisoned in the Temple.

The Commune of Paris, who, under Danton's leadership, had organised the insurrection, became virtual rulers of France. There was strong monarchical feeling in the provinces, the *bourgeois* majority in the Assembly was moderate, but they were cowed by the violence of the mob and the organised terrorism of the Jacobins. The Commune obtained the right of domiciliary search for suspects and forced the Assembly to create a Special Revolutionary Tribunal.

The advance of the Prussians facilitated the progress of the revolution. On September 2, 3, and 4, the mob, instigated by the Commune, broke into the prisons, which were crowded with suspects, and massacred 1,400 of both sexes—priests,

royalists, "aristocrats," and common criminals alike.

Meanwhile, a National Convention had been elected to succeed the Legislative Assembly, and, by the free use of proscription and terrorism, the representatives of Paris were mostly restricted to the Jacobin group. The majority in the Convention, known as the Plain, consisted of men of little weight and no strong opinions, swayed alternately by the active groups to their right and left.

The Girondins, so called because their leaders came from the department of the Gironde, represented the *bourgeois* class, and had leanings towards orderly and constitutional government. Among the most prominent were Vergniaud, the greatest orator of the Revolution, Brissot and Condorcet.

The Mountain represented the extremist elements. Among them were Carrier—subsequently notorious for his massacres at Nantes—Tallien, Collot d'Herbois, Billaud-Varennes—above all Danton, Camille-Desmoulins, Marat, St. Just, and Robespierre.

Danton was undoubtedly the strongest man in France. A lawyer in good practice, he had thrown himself into the Revolution with energy. He was a man of lion-like voice and character. A sincere democrat and a passionate patriot, he was reckless of human life to attain his ends—but he desired a strong government, and he was at once the most far-sighted and the most practical statesman of the Revolution.

Maximilien Robespierre

Camille-Desmoulins had brought great powers of eloquence and sarcasm to the task of a revolutionary journalist. Stained with the worst excesses of the time, there is still a human savour about him.

Marat, a squalid person who had been a doctor, combined enthusiasm for equality with a strong taste for bloodshed. This *Ami du Peuple* had hounded on the mob to the September massacres. St. Just was a fanatic of the *Contrat Social*, sincere, narrow, dangerous. His master, Robespierre, remains the sphinx of the Revolution. He was a lawyer who had resigned a judgeship rather than pronounce sentence of death. He lived to be the supreme wielder of the guillotine.

It is agreed that Robespierre was personally incorruptible, strict in morals and kindly in private life. It is disputed whether he was, politically, a monster of cruelty, a sincere fanatic, or a timid mediocrity driven into excesses by panic. Carlyle's well-known epithet of "the sea-green incorruptible" is admirable but does not fully solve the enigma of his character and power.

The history of the Convention is the struggle between the Girondists and the Jacobins for its control. On September 21, 1792, both parties united in a decree abolishing the Monarchy, but immediately after dissension broke out between them.

The Mountain pressed for the death of the King, using the threatening attitude of Europe as a plea for drastic measures. The only punishment provided by the Constitution was deposition. Robespierre and St. Just demanded his death as an act of public policy and wished for no trial. The majority, less logically, determined on a trial which could have no legal basis.

Death of the King

On December 26 the trial took place before the Convention. His advocate Desize, who had been assisted by Malesherbes, did his duty bravely and refuted the specific charges preferred. But the case had been prejudged. The Girondists strove for an appeal to the people. They were overborne by the violence of the Mountain. The appeal to the people was refused and a small majority pronounced for death.

Vergniaud voted with the majority, and on January 21, the day after the final vote, the King suffered with the passive courage which distinguished him.

The execution of the King armed all Europe against the Republic. Further, a revolt broke out in La Vendée, where the peasants were attached to the King and Church.

The Girondist ministry was too weak to face the situation. Danton, whose whole soul was in resistance to foreign enemies and who was now inclined to moderation, offered them his powerful help. He was rebuffed and threw in his lot with the extremists as the only chance of establishing a strong government.

The Revolutionary Tribunal, which had been suppressed, was revived and a Committee of Public Safety was established with dictatorial powers.

The raising of troops and defence of the country was energetically carried on under Danton's inspiration, but the revolt in La Vendée became formidable, and risings broke out at Lyons and elsewhere. A new Committee of Public Safety was elected, composed of the followers of Robespierre, who had identified himself with the most extreme section. Danton pleaded for an amnesty and for orderly government, but the ex-

From the painting by Fred Roe, R.I.; exhibited in the Royal Academy, 1910.

ARISTOCRATS, 1792.

During the year which followed the establishment of the Revolutionary Tribunal some 2,500 persons—persons of both sexes, priests, royalists, and common criminals, as well as aristocrats—were in Paris alone brutally dragged to the guillotine. In the whole of France 15,000 or more people perished.

tremists dared not venture on a compromise which might imperil their own safety.

Carnot, who was added to the Committee of Public Safety, did miracles in reorganising the Army, but his colleagues thought more of sending aristocrats and moderates to the guillotine. The fall of Toulon to the royalists and English added to their activity. Hébart, a foul-mouthed ruffian who edited the infamous *Père Duchesne*, became a leading spirit.

A "Law of the Suspect" gave power to send almost anyone obnoxious to the ruling faction to the scaffold. Lyons and Toulon fell and their fall was followed by massacres. The Vandeans were defeated and a ghastly butchery followed. Carrier drowned them by hundreds in the Loire.

Marie Antoinette, after a trial in which Hébart behaved with revolting brutality, was guillotined on October 16.

Execution of Danton

Vergniaud and the best of the Girondins perished, Malesherbes and Lavoisier were among other victims. The Reign of Terror was in full swing. Christianity was abjured, and Notre Dame consecrated with peculiar rites to the worship of Reason—a strange paradox indeed at a time when rational conduct led straight to the guillotine.

Danton and Camille-Desmoulins attacked the brutal ferocity of the Hébartists, and Robespierre made use of them to remove these rivals from his path. Hébart and his followers were beheaded. Then Robespierre and St. Just turned on Danton. The charges against him were a tissue of falsehoods. He fought for his life with magnificent energy; his thunderous voice could be heard across the river.

It was, however, all in vain. The greatest man of the Revolution was condemned as a concealed royalist. Camille-Desmoulins went with him to the scaffold.

Robespierre, now almost sole ruler of France, desired to use, but to regulate, the Terror. He decreed the existence of a Supreme Being and increased the powers of the Revolutionary Tribunal. In 47 days 1,400 persons perished. Tallien, Collot and Billaud began to tremble for their own heads.

A conspiracy arose which Robespierre had not sufficient strength to repress. His supporters in the Convention were silenced, he himself was shouted down with cries of "*A bas le tyran.*" Both he and St. Just were arrested. The Plain at last asserted itself. Barras with an armed force held down Paris, and Robespierre—his jaw broken by a pistol shot fired either by himself or by an assassin—was hurried to the scaffold. St. Just and his other supporters perished with him.

They were the last victims of the Terror.

In 420 days since the establishment of the Revolutionary Tribunal 2,625 persons had been guillotined in Paris alone. The number who perished throughout France on the scaffold, by shooting, by drowning, was estimated at 17,000. The true figure is probably much higher.

The death of Robespierre broke the spell which the organisation and audacity of the Terrorists had laid upon France. Numerically they were always a small minority. They had contributed little to the safety of France.

Now that Robespierre was dead the moderate Republicans reasserted themselves. Billaud, Collot and their colleagues who had only aimed at destroying their rival found themselves helpless against the reaction. Prisoners were released. The Revolutionary Tribunal was reconstituted and began to acquit those accused before it. Much confiscated property was restored. Hoche pacified La Vendée. Freedom of worship was revived.

Napoleon Bonaparte

An attempted insurrection on April 1 was suppressed, and the remaining Terrorist leaders were deported. In the South the "White Terror" broke out and royalist partisans worked a bloody retribution on the Jacobins.

On June 10 the Dauphin (called Louis XVII.) died in prison as the result of brutal ill-treatment followed by scandalous neglect.

Louis XVIII.—an exile in England—adopted a reactionary attitude which ended the hopes of the royalists. The Convention adopted a Constitution embodied in a Council of Five Hundred, a Council of Ancients, with a suspensory veto, and a Directorate of Five who held the Executive power.

To guard against the election of royalists, two-thirds of the Councils were to be chosen from the Convention. On October 5 (13 Vendémiaire), according to the new Republican calendar, 1795, a popular rising was suppressed by the energy of the Director Barras, assisted by Napoleon Bonaparte, then a young officer of artillery. The Convention sat until October 26, passing many excellent measures of educational, legal and social reform.

J. B. S.-B.

Continued from page 405.

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ELECTRICITY AND MAGNETISM.—XXIV

Faraday's Ice Pail Experiment.—One of the most important facts of electrostatic induction is the relation of the magnitude of the inducing charge to that of the induced charge or charges. When an insulated conductor is electrified, all objects existing within the field of the charged body are influenced inductively. Thus a brass sphere in a state of positive electrification induces electricity of a negative nature on the ceiling, on parts of the floor and walls of the room, as well as on other smaller objects placed in the room. Is the magnitude of the electricity induced on all of these objects taken together, i.e. the total induced charge, equal to that of the charged sphere?

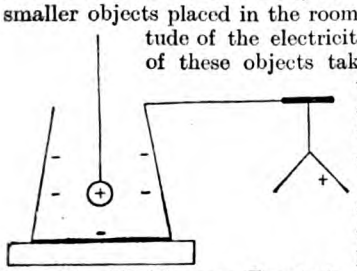


Fig. 84.—To illustrate Faraday's ice pail experiment.

In order to find an answer to this question we may perform an experiment similar to that which was performed by the famous scientist, Faraday.

Experiment 80.—*To prove that the induced charge is equal in magnitude to the inducing charge.*

Place a tall can or tin, preferably one which narrows towards the open end, on a block of dry glass.

By means of a wire connect the insulated can to a gold leaf electroscope. Using a dry white silk thread, suspend a small spherical conductor, which has been charged positively by means of an electrophorus. White silk is preferable for purposes of suspension since colouring matter may be conducting. Now lower the charged conductor into the can, being careful to see that the can and the conductor do not touch each other. What happens to the leaves of the electroscope as the charged sphere is lowered towards the base of the can? The positive electricity on the conductor induces a corresponding negative charge on the sides and base of the can, while positive electricity is repelled from the can to the electroscope, hence the leaves of the latter diverge. Now touch the can with the finger. The leaves of the electroscope collapse since the induced free positive electricity escapes to earth, while the negative induced charge is held bound by the positive electricity on the sphere. Allow the charged sphere to come in contact with the base of the can. Do the leaves again diverge? Evidently there is no electricity on either the sphere or the can. When the two electrified objects come in contact, the positive charge on the sphere neutralises the negative charge on the can. If the induced electricity were either greater or less than the inducing charge, a surplus of one kind or the other would remain on the can after the sphere had touched it, and the presence of any such remaining electricity would be indicated by divergence of the electroscope leaves. Hence the total induced charge is equal in magnitude to the inducing charge.

We must observe carefully that, since a tall can was used in our experiment, practically all of the inductive influence of the charged sphere was exerted on the metallic can. A similar experiment performed with a toy bucket, the open end of which is greater than the base, would yield results different from those of the last experiment, since an appreciable amount of the inductive influence would be exerted upon the ceiling of the room.

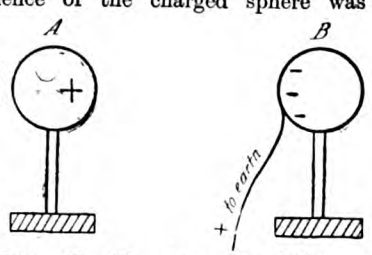


Fig. 85.—To show the influence exerted by an earth-connected conductor placed within the field of an inducing charge.

Another interesting matter relating to induction is the influence exerted by any earth-connected conductor placed within the field of an inducing charge. Consider an earthed conductor *B* in the field of an insulated positively charged conductor *A*.

B will be influenced inductively, negative electricity appearing on *B* opposite the inducing positive charge of *A*, while repelled positive electricity of *B* escapes to earth. Under these conditions any other conductor shielded from *A* by *B* will not be influenced by induction; or in other words, all objects in the *electrical shadow* of *B* will be screened from induction due to the charge on *A* (Fig. 85).

With a little thought the student can suggest an experiment with the gold leaf electroscope to illustrate this point.

Distribution of Charges on Conductors. — When we charge an insulated conductor with electricity of either kind, the electricity spreads over the conductor, as it were; but do all parts of the conductor bear equal portions of the charge, just as water poured into a horizontal flat dish with upright sides arranges itself with the depth at any one part equal to that at any other part? The distribution of both water and electricity depends largely upon the shape of the objects containing them. Water in a trough with an uneven base is deeper at some points than at others. Electricity on a conductor the surface of which is not uniform is not of the same density at all points, but whereas water is deeper where there are hollows, electricity is more dense where there are projections, not hollows. If, for the sake of argument, we imagine that electricity has thickness, we may illustrate by means of dotted lines its distribution on conductors of different shapes.

A PROOF PLANE may be made by mounting an old halfpenny on a stick of sealing-wax.

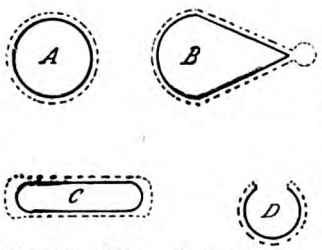


Fig. 86.—Illustrating the distribution of charges on conductors of different shapes.

In the case of a sphere, as at *A* in Fig. 86, electricity is distributed evenly over the entire outer surface, but no electricity ordinarily exists on the inner surface of a hollow conductor, as in the case of *D*. The charge on a cylindrical conductor with rounded ends (*C*) is more dense over the extremities than along the main part of the conductor. Special interest is attached to the case of a conductor which tapers to a point (*B*). In the region near the point the charge may become so dense as to escape from the point on to air particles. Such an escape is called a *brush discharge*, since the air particles receiving the electricity move away from the point in the form of a fan or brush. The density of an electrical charge in the region of a point explains the necessity for our using for experimental purposes conductors devoid of points or sharp edges. Should a conductor possess a reentrant hollow, i.e. a bulge inwards, no electricity will occur in the hollow, and for this reason a depression in the ground is likely to be a place of safety during a thunderstorm. How do we know that electricity is distributed over conductors in the way we have described?

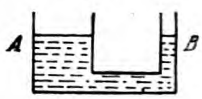
The Proof Plane.—If we have conductors of various shapes at our disposal we may charge them electrically one at a time, and take sample charges from different parts of their surfaces. A simple piece of apparatus called a proof plane is employed for obtaining the sample charges, while the amount of divergence of the gold leaf electroscope will indicate the relative density of the electricity at those parts of each conductor from which the sample charges are taken.

A proof plane consists of a small circular metallic disk with an insulating handle. One may be constructed by mounting a smooth (i.e. old) halfpenny on a stick of sealing-wax.

Experiment 81.—*To investigate the distribution of electrical charges on conductors of different shapes.*

Select a few conductors composed of tin foil on wood, and charge them with electricity by means of the electrophorus. Take each one separately and test different portions of the surface by touching various places with the proof plane, and by bringing the proof plane near the electroscope. When the density of the charge at one point has been investigated, discharge the proof plane by passing the hand over it before proceeding to test another part of the same conductor. How do your results agree with Figure 86?

Potential and Capacity.—Whenever an insulated charged conductor is allowed to come in contact with another uncharged conductor, some electricity suddenly escapes from the charged conductor on to the other, or in other words, the original charge of one is shared by both.



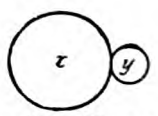


Fig. 87.—Illustrating the explanation of potential and capacity.

Two very important questions now arise. Why does the electricity pass from one conductor to the other, and do the conductors take equal portions of the original charge or not?

Let us consider Fig. 87. The upper part of the diagram represents two troughs of unequal size, *A* and *B*, connected by means of a pipe and containing water. The water is at the same level in both *A* and *B*. Under these conditions there is no flow of water, but should more water be placed in *A*, a difference of level would occur, and water would pass into *B* until the water level was the same in *B* as in *A*. Now *A* is much wider than *B*, hence it requires much more water than *B* to bring the water in both to the same level. The capacity of *A* is greater than that of *B*. The spherical conductors *x* and *y* are very similar. If *x* possesses a charge of electricity and *y* does not, then if they are brought in contact, electricity passes from *x* into *y* because the potential or electric level of *x* is higher than that of *y*. But *x* has a much greater surface than *y* has, hence *y* will require less elec-

tricity to bring its potential to any definite level than the amount necessary to bring the potential of x to the same level. *The electrical capacity of x is greater than that of y.*

When two or more conductors whose potentials are different come into contact, electricity passes from the conductors having the higher potential to those having lower potentials so that they acquire a common potential, but the charge of electricity will be shared by the conductors in proportion to their respective capacities.

In the case represented by Fig. 87, the potentials of x and y become the same on contact being made, but the charge on x is much greater than that on y.

Experiment 82.—*To show that the greater its surface the greater the capacity of a conductor.*

Take a piece of tin foil about three inches long by one and a half inches in width. Fasten one end to a round stick of sealing-wax in such a way that the tin foil may be wound or unwound by rotating the sealing-wax. In this way you construct an insulated conductor whose surface area can be made larger by unwinding it, and vice versa. Connect the free end of the tin foil to a gold leaf electroscope by means of a wire. Charge the tin foil and note the behaviour of the electroscope leaves as you wind or unwind it.

Now the charge on the tin foil remains constant but the surface varies as you unwind or wind up, hence the potential varies, being highest when the tin foil is wound up, i.e. when the surface is smallest. *Hence the capacity of a conductor depends upon its surface area, the greater the surface the larger the capacity.*

This general relation between capacity and surface holds good in the case of ordinary insulated conductors, and in the case of spheres, then capacity varies according to the dimensions of their radii.

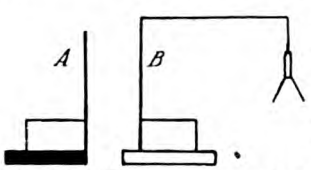


Fig. 88.—To demonstrate the principle of a condenser.

Condensers.—Is there any method of altering a conductor so that its capacity does not conform to the ordinary rule relating to surface area ?

Experiment 83.—*To illustrate the principle of a condenser.*

Connect a small insulated conductor to the gold leaf electroscope. Give it a small charge from the electrophorus and note the degree of divergence of leaves. Now bring near, but not touching the charged conductor, another conductor which is connected with the earth either through the person or by means of a metallic support. What effect is now produced on the leaves ? The potential of the charged conductor is lowered. If its potential is to be brought up to the original level, more electricity of the same kind must be given to it, therefore its capacity is increased (Fig. 88).

The presence of an earthed conductor increases the capacity of an insulated conductor near it. An arrangement consisting of an insulated conductor placed near an earthed conductor is called a *condenser*. A simple condenser consists of two metallic plates, one insulated the other earthed, the space between them being occupied by air. L. M. P.

BOTANY.—XIX

53. The Fruit.—After fertilisation, as we have seen, the ovules change into seeds ; concurrently with this change, the wall of the ovary itself enlarges and sometimes becomes greatly altered, so that a *fruit* is formed. Thus a fruit is botanically defined as a modified ovary containing seeds. The wall of the fruit is called the *pericarp*.

When the fruit contains many seeds, it is evidently an advantage that it should open, so that the seeds may be scattered : otherwise they will all seek to develop in one place, with disastrous results to many of them. Hence we find many fruits are *dehiscent*, and open of themselves to liberate their seeds. *Indehiscent* fruits generally have but one seed ; when they fall, the pericarp gradually rots, and the single seed then germinates wherever it may have fallen, away from the competition of similar seeds.

The simplest kind of indehiscent fruit is the *achene*, of which the common nut is a familiar example (Fig. 131). The achene is

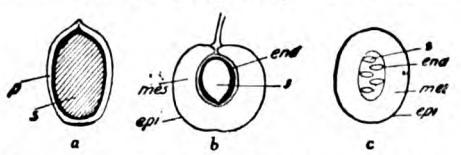


Fig. 131. — Types of indehiscent fruits: (*a*) achene ; (*b*) drupe ; (*c*) berry.

a dry, one-seeded fruit with a tough, skinny or hard pericarp. It is generally formed from a single carpel, as in the buttercup ; or from a unilocular syncarpous ovary containing one seed, as in dandelions and other Compositæ. In the latter case, as in grasses, the pericarp is inseparable from the testa of the seed.

A fleshy indehiscent fruit is the *drupe*, of which the cherry is an example. Here the pericarp is easily seen to have three well-marked layers : a skinny *epicarp*, enclosing the succulent *mesocarp*, which surrounds the stony *endocarp*, which acts as the protector of the single seed. The drupe must be distinguished from the *berry*, in which the endocarp is succulent as well as the mesocarp. Moreover, the berry may have many seeds, as the gooseberry ; and it may be multilocular, like the orange. But it is one-seeded in the date, in which the stony portion is really the endosperm of the seed. Other berries are the tomato, grape, currant, cucumber, banana, and deadly nightshade ; among the drupes are plum, raspberry, almond, and walnut.

A collection of apocarpous fruits is called an *etœrio :* e.g. the buttercup or clematis forms an etœrio of achenes, and the blackberry is an etœrio of drupes.

Two main kinds of dehiscent fruit may be described—the pod and the capsule. The

Fig. 132. — Shepherd's Purse.

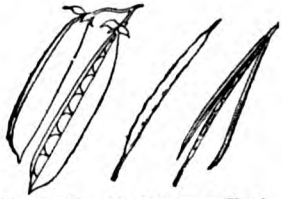


Fig. 133.—Wallflower Fruits.

simplest kind of pod is the *follicle*, seen in Christmas rose and marsh marigold ; the dehiscence is here by one slit only, and takes place along the ventral suture. In the *legume*, dehiscence takes place along both the ventral and dorsal sutures, as in the pea and other Leguminosæ. Both the follicle and the legume come from single carpels ; but a bilocular ovary forms the pod of the wallflower and other Cruciferæ. Such pod is known as a *siliqua*. It dehisces from below, along the edges of the partition which carries away with it the placentas and hence the seeds. This middle partition remains suspended from the top of the fruit after dehiscence ; as it dries, the seeds become detached and are blown away. A short, stout siliqua, such as that of shepherd's purse, is often spoken of as a *silicula* (Fig. 132).

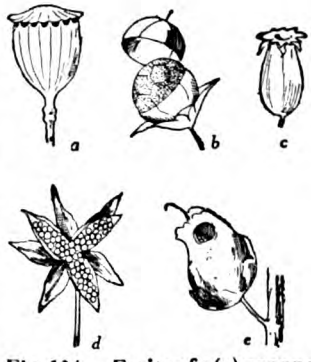


Fig. 134.—Fruits of : (*a*) poppy ; (*b*) pimpernel ; (*c*) campion ; (*d*) pansy ; and (*e*) antirrhinum.

The *capsule* is formed from a syncarpous

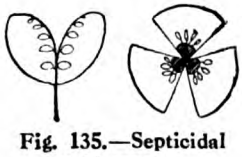


Fig. 135.—Septicidal dehiscence.

Fig. 136.—Loculicidal dehiscence.

ovary, and there is considerable variety in the modes of dehiscence. In the capsule of the poppy, a ring of small holes or pores forms immediately beneath the cap of the capsule, and the seeds are projected through these holes as the fruit is swayed about by the wind (Fig. 134). In the scarlet pimpernel and plantain, the dehiscence is transverse ; a small cap is cut off and leaves the seeds exposed. In the primrose the capsule is opened by means of five valves, which curl back in dry weather. In the snapdragon two or three holes develop at the apex of each carpel. The most frequent form of dehiscence is, however, by means of longitudinal slits. These slits may occur along the partitions between the carpels, thus separating the ovary into its constituent parts without necessarily opening them. This is called *septicidal* dehiscence (Fig. 135), and is followed, as in snapdragon, by a further dehiscence of the separate parts. In the pansy, iris, and other forms the slits form along the dorsal suture and the interior of the carpels is exposed : this is *loculicidal* dehiscence (Fig. 136).

Some syncarpous ovaries separate into their constituents before dehiscence begins. Then each carpel is to be regarded as a separate fruit—a capsule or an achene, as the case may be. Such fruits are spoken of as *schizocarps*, and they occur in geraniums, garden nasturtium and in all members of Labiatæ and Umbelliferæ.

Sometimes the conspicuous part of a fruit is not derived from the ovary, but from some other part of the flower. Such "fruits" are known as *pseudocarps* or false fruits (Fig. 137). In the strawberry the true fruits are the pips, which are minute achenes ; the fleshy part of the strawberry is a greatly enlarged receptacle. The receptacle is also the conspicuous part of the "hip" as well as the

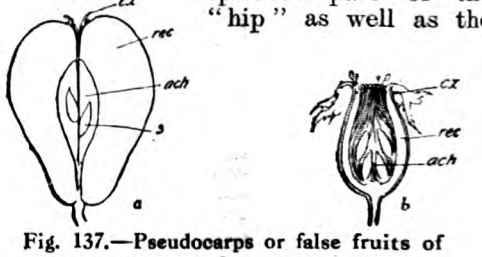


Fig. 137.—Pseudocarps or false fruits of (*a*) pear, and (*b*) hip.

"haw," enclosing the true fruits (achenes) in each instance. The fleshy part of the apple or pear is also derived from the receptacle which has made the achenes look as if they were syncarpous. The calyx becomes succulent in mulberry and in pineapple. In the fig the fleshy portion is the hollowed-out axis of the inflorescence, and the pips (achenes) are again the true fruits but arise from many flowers instead of one.

Special growths will often develop as the fruit is forming, and are prominent parts of the final result. The familiar *cupule* or little cup of the acorn is a case in point. In the beech, the cupule is much larger than in the oak and encloses the nuts completely until it dehisces. The Spanish chestnut has a similar structure ; but the prickly cover of the horse-chestnut, an unrelated plant, is the pericarp of a true fruit (a capsule). On the yew, a special scarlet and fleshy cup, known as an *aril*, partially surrounds the dry, hard seed. An external aril develops also around each of the four seeds in the capsule of the spindle-tree, and is very conspicuous when the fruits dehisce.

We must note finally the cones of the pine and other trees. The seeds are retained in the closed scales for a long time : when the cone is thoroughly dry, the scales separate and the seeds escape. Cone-like fruits are found also on the alder and the birch among angiospermous trees.

54. The Dispersal of Seeds.—It is unnecessary to dwell upon the advantages that a species derives from being able to get its seeds transported to new localities. The colonisation of fresh ground, and the spread of the species, would alike be impossible if there were no means of getting the seeds carried. As in the case of pollination, chance is an important element in the result ; yet very many plants have remarkable interesting devices to assist the process.

The agencies called in to help the plant

Fig. 138.—Wood avens develop hooks on the tip of the style.

Fig. 139.—Goosegrass : showing how hooks are borne on the fruit itself.

are either living or mechanical agents. Any succulent fruit, for instance, is likely to be eaten by birds. The stony portion will pass through the bird's body unchanged, and be deposited far away from the parent plant. Hence the seeds contained in drupes and berries have, as it were, provided for their own transportation. In the mistletoe there is even more ; the juicy part of the berry is sticky and adheres to the beak of the bird, who rubs it off on a tree-trunk where the mistletoe will make its home. Drupes and berries also have a skinny and very acid epicarp which is useful in preserving the succulent tissue against small insects.

Quite another device is that of the development of hooks on the tips of the style, as in the wood avens (Fig. 138). Here there is a cluster of achenes with persistent styles, each of which has a hook by means of which it is caught by the fur or skin of a passing animal. In the burdock the hooks are the tips of the whorl of persistent bracts, and the whole head is broken off, forming the well-known bur of our hedges and woods. In the goosegrass (cleavers) the hooks are borne on the fruit itself, while they form a ring on the edge of the persistent receptacle in agrimony (Fig. 139).

An animal which tramps muddy fields or woods, or a bird which wades in marshy land, is likely to carry many seeds in the mud which adheres to its feet.

Of mechanical aids to seed-dispersal, the

Fig. 140.—Seeds of (*a*) elm ; (*b*) ash ; (*c*) sycamore.

most potent is the wind. Some plants—many grasses, orchids, wild parsnip, etc.—have very light seeds which are easily blown about. Other seeds become light through buoyant hairy attachments. Thus the seeds of willows, poplars, and willow-herb have a covering of fine silky hairs which are spread out in the wind and carry the seeds a great distance. The appearance of the capsules, full of hairy seeds, is a characteristic feature of these plants in summer.

The dandelion and many other Compositæ produce the well-known puff-ball (known as a *pappus*) after fertilisation. Each of the many fruits formed from the head is an achene, on the top of which a fringe of hairs is found. Blow the pappus, and you will observe the separate fruits sail away in the air like parachutes.

Some seeds or fruits are made buoyant by means of a flattened membranous extension of the testa or pericarp. Of such nature are the seeds of pines, and the *samaras* or winged fruits of elm, ash, maple and sycamore (Fig. 140).

The two latter are double fruits with two wings, and a few trials will show that it is almost impossible to get either of them to fall vertically. In the elm the fruit is central

and the wing very light ; but in the ash the wing is one-sided, something like one half of the sycamore fruit. The fruits of the lime are small and dry, and are transported by the membranous bract which is attached to the inflorescence.

The seeds or fruits of water-plants are generally transported by water, as we should expect ; but few land-plants resort to this method. The coco-nut palm is one of the best examples ; the so-called nut—in reality the stone is the endocarp of the fruit—is made buoyant by its adherent apparatus of fibres, the oakum of commerce.

Certain fruits, such as those of balsam, gorse and medick, become explosive as they dry, owing to the various layers of the pericarp contracting unequally. The result of this is that the fruit " explodes " on being touched, and the seeds are scattered a considerable distance. In the wild geranium

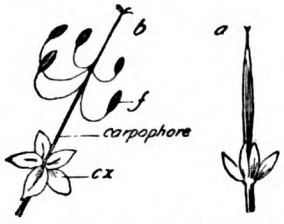


Fig. 141.—Fruit of Crane's Bill.

Fig. 142.—Achene of Wild Clematis.

(crane's bill), the fruit is a schizocarp, and the five carpels separate in a rather peculiar manner (Fig. 141). The ovaries separate, but the styles remain adherent to a prolongation of the receptacle, known as the *carpophore*. The styles then coil up as they dry, and the ovaries dehisce ; on being moistened the styles tend to straighten themselves again, and, as they do so, the seeds are shot out of the fruits some little distance.

If the seed alights in a favourable place, it finds a little crevice in the soil ; rain helps to wash it further in ; and thus it finds a warm resting-place for the winter. A few fruits are provided with special devices to ensure the seed being well set. The achenes of the wild clematis (Fig. 142) have a persistent style which is hygroscopic, coiling up and straightening out again as the weather is dry or wet. The process is aided by the pointed nature of the achene, and by the hairs which cover it. These hairs point upward ; they therefore offer a resistance to the fruit being drawn out of the soil by the action of the style. Such a hairy style is called an *awn*.

E. W. E.

GEOLOGY.—VI

Distribution of Land and Sea.—Looking at a globe, it can be seen at a glance that there is a predominance of land in the northern and of water in the southern hemisphere (*see* maps, Vol. I., p. 490). At the poles, however, this contrast is reversed. Around the north pole lies the frozen Arctic Ocean ; around the south pole is the ice-shrouded continent of Antarctica. In fact, with only a slight exception in the case of part of China and part of South America, it can be stated as a generalisation that each great land mass has a corresponding great sea or ocean for its antipodes. Land and sea fall diametrically opposite one another.

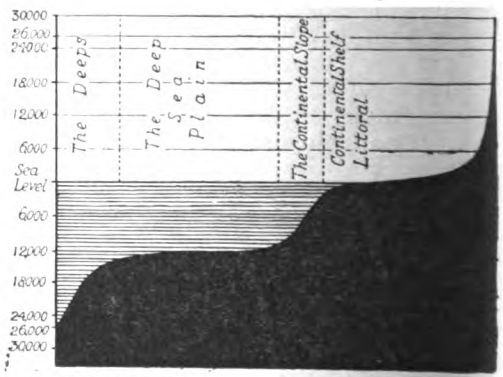


Fig. 43.—The Hypsographic Curve.

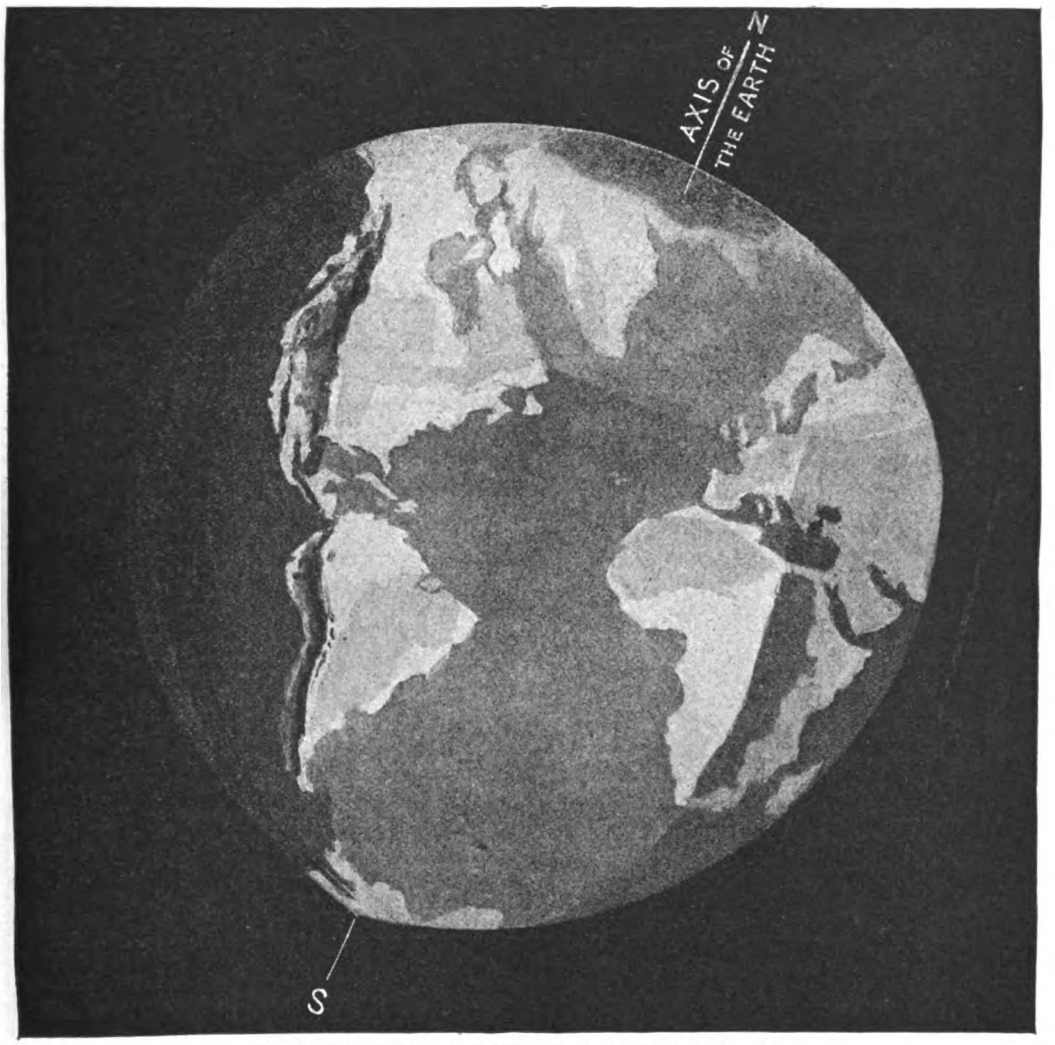
The land masses, especially of the northern hemisphere, have a habit of terminating in triangular forms, with the apex towards the south. These can be arranged in three groups : (1) North and South America ; (2) Africa ; (3) India, Malaya, and Australia. Between them are the Atlantic, Indian, and Pacific Oceans. These features, which show that the arrangement of land and sea is not without order, have been explained by Lowthian Green on the assumption that the earth is like a tetrahedron in form.

The Hypsographic Curve.—The proportion of land and sea between certain levels can be very usefully represented in a diagram in which height and depth above sea level are measured vertically, and areas corresponding to each level are measured horizontally (Fig. 43). The curve so obtained —the hypsographic curve—shows in a greatly exaggerated way the average form of the ocean floor. It thus appears that the oceans have a basin-like form. The flat floor of the basin, having an average depth of a little more than 12,000 feet, is called

the *deep sea plain*. In it are narrow depressions called the *deeps*, with relatively steep sides. The sides of the basin form the *continental slopes*, which rise fairly steeply to a depth of 100 fathoms or 600 feet. This level really represents the top of the basin, for from it the sea-floor gently slopes upwards to the lands, and is, indeed, best regarded as a submerged outer rim of the great land-masses. For this reason the floor between low-tide level and 600 feet is called the *continental shelf*. It is as though the ocean basins were overfull and the seas had submerged the first 600 feet of the true continents. Between low- and high-tide marks the overflow swirls backwards and forwards with the tides, and this narrow strip, where land and water meet, is called the *littoral*.

The dissolved salts in the ocean waters have the following average composition by weight:—

Sodium chloride	=	27·213	parts per 1,000
Magnesium chloride	=	3·807	,, ,,
Magnesium sulphate	=	1·658	,, ,,
Calcium sulphate	=	1·260	,, ,,
Potassium sulphate	=	0·863	,, ,,
Calcium carbonate	=	0·123	,, ,,
Magnesium bromide	=	0·076	,, ,,
Total salinity	=	35·000	,, ,,



THE TETRAHEDRAL THEORY OF THE EARTH,

i.e., the theory that the earth is like a tetrahedron in form, has been advanced to explain why the land masses of the northern hemisphere terminate in triangular shapes, with the apex towards the south.

The average density of the ocean is 1·026.

Area of lands	= 52,000,000 square miles.
Area of oceans	= 145,000,000 square miles.
Mean depth of oceans	= 2·124 miles.
Volume of ocean waters	= 308,000,000 cubic miles.
Mass of ocean waters	= 1,180,000,000,000 million tons.
Mass of salts in solution	= 41,300,000,000 million tons.
Mass of sodium in solution	= 12,600,000,000 million tons.

The salts in the ocean are, of course, the accumulations of material brought from the lands by solution in river waters. Most of the substances, however, re-enter the deposits formed on the ocean floor. Calcium is abstracted by organisms in the form of calcium carbonate, and built up into their shells as calcite or aragonite. When the organisms die, the shells accumulate to form beds of limestone. Magnesium salts act on the limestones so produced, forming dolomites and magnesian limestones. Potassium is abstracted by clayey matter in the presence of iron to form the green granular mineral known as *glauconite*. Sodium has been little affected by subsequent changes, and its amount in the oceans therefore represents almost the whole accumulation which has taken place since the beginning of geological time.

Fig. 44.—The coast of Pembrokeshire, South Wales, showing how the form of a coast line is largely determined by the nature of the rocks.

***Black**=Igneous rock, "greenstone" except the large mass in the S.E., which is cranophyre; **Shaded**=Cambrian grits and sandstone; **Unshaded**=Ordovician soft slates.*

If, then, we knew the rate at which sodium has been added to the oceans year by year, it would be possible to form an estimate of the age of the oceans. Average igneous rock contains 2·52 per cent. of sodium, and it is from this igneous rock that all sedimentary rocks and ocean salts have been derived. The sedimentary rocks themselves contain 0·95 per cent. of sodium, and consequently the difference, 1·57 per cent., represents the loss of sodium which the original rocks have suffered at the hands of denudation. Hence, the total amount of sodium in the ocean is equivalent to 1.57 per cent. of the whole amount of igneous rock which has been denuded away during geological time. That quantity is therefore 800,000 million million tons, and the total quantity of sedimentary rocks in existence must therefore be of this order, but necessarily a little less.

Now we have seen, p. 331, that the lands are *now* being worn away at the rate of one foot in 8,600 years. Igneous rock, however, is only denuded at a third or even less than this rate—i.e. one foot in 25,800 years. The amount of igneous rock now exposed is about 8 million square miles, and this corresponds to a production of sodium of 12 million tons per annum. On this basis the age of the ocean would be given by—

$$\frac{\text{Amt. of Na in ocean}}{\text{Annual income of Na}} = \frac{\text{12,600 million million tons}}{\text{12 million tons}}$$

= 1050 million years.

This result is, of course, subject to two main corrections, (*a*) the rate of denudation—i.e. the rate of sodium production—is probably higher at the present time than it has been on the average in the past; and (*b*) there may have been more igneous rock exposed in the past than at present. But the first correction would tend to increase the age; the second to decrease it.

Marine Denudation. — It requires no discussion to show that the wearing away of the lands by the sea is chiefly dependent on wave action. Waves dash up strongly against the rocks, and their most effective action takes place at levels between the crest of the wave and the trough. The pressure of the Atlantic waves on the western shores of our islands varies from 600 lb. to 2,000 lb. to the square foot, becoming even greater in severe storms.

Sedimentary rocks are more rapidly attacked than hard homogeneous rocks like granite and basalt. Fissured and jointed rocks

are less able to resist the bombardment of the waves than indurated and unjointed rocks. Comparatively soluble formations, like limestones, do not withstand the water as well as insoluble rocks. It follows from these facts that the form of a coast line is largely determined by the nature of the rocks. The west coast of Pembrokeshire is a classic example. St. David's Head and Ramsey Island stand out because they are built of hard igneous rocks (Fig. 44). Whitesand Bay and St. Bride's Bay have been excavated in softer sedimentary rocks (Coal Measures).

Cliffs and Wave-cut Terraces.—Cliffs are formed by the undermining scour of the waves, but their actual form is controlled by the action of other agents of denudation, and by the stratification and jointing of the rocks themselves. When the bedding dips towards the sea and joints (at right angles to the bedding) dip towards the land, large blocks are easily broken away, and the cliff rises in overhanging steps. Landslips also tend to occur in these circumstances. In the reverse case, where the bedding is away from the sea and the joints towards it, the blocks are held up until undermining has proceeded much farther than in the preceding case.

Marine denudation constantly tends to steepen a cliff by wearing it away at the base, but the action of the weather tends to wear away the top. The actual slope here depends on whether marine or subaerial denudation proceeds the more rapidly.

When rocks are well jointed, isolated pinnacles and stacks are developed, since erosion proceeds most effectually along the joints. Vertical masses of rock which once formed parts of the worn-back land are thus gradually separated from the main line of cliff as the waves advance. Limestone rocks, where solution also helps to widen the joints, illustrate the formation of stacks admirably—e.g. the Needles, Marsden Rock (Durham), the King and Queen Rocks (Flamborough).

Transport and Accumulation. — The sand and shingle which are cast up around the borders of the land by wave action and currents constitute the *beach*. Beaches especially tend to accumulate along gently sloping shores of soft rocks, or in indentations between harder rocks. Strong currents and oblique waves both tend to sweep away beach material. When waves are oblique to the shore their load of debris is carried up the shore slope in the same direction—i.e. it is carried forward parallel to the coast, as well as upward at right angles to the coast. When the water falls back, however, it takes the steepest path, which is generally at right angles to the coast, and some of the material is drawn back with it. For this reason sand and shingle may take a zigzag course, the net result of which is a forward movement. This effect of oblique waves and also of currents is well illustrated in the English Channel, where the movement is from west to east.

Groynes are erected in many places to prevent the migration as far as possible. Walking along the south coast it is a matter of common observation that the shingle is heaped up on the west side and carried away from the east side of the groynes. Almost any coast will illustrate another peculiarity of marine deposition. The coarser gravels and pebbles are heaped up just above high-water level. The reason for this lies in the fact that the forward-moving waves can carry materials varying from fine sand to large pebbles. The back wash, however, is less strong, and only draws back the lighter or more finely graded material. Above a certain limiting size all the material is thrown up and accumulates; below that critical size the tendency is to be drawn back. Consequently from the boulder beds of the upper beach there is every gradation of finer and finer material towards the sea and outwards over its floor.

When a current reaches deep water in front of a bay or estuary, its carrying power is reduced and its burden of shingle is dropped. The *bar* across the mouths of many rivers is so produced. Generally, however, a river itself carries material and keeps a channel open. A long ridge or spit is then formed, the sea current carrying material on the outside, and the river current carrying material on the inside. Where they meet their burden is dropped, and the spit gradually lengthens.

Coastal Features due to Earth Movement. — The importance of raised beaches in indicating a fall of sea level or a rise of the land, and of submerged forests which testify to a rise of sea level or a fall of the land, has already been mentioned. The *fact* of earth movements, resulting in a retreat or advance of the sea, need not therefore be further insisted upon.

Deltas are characteristic of coasts from which the sea is retreating and the zone of deposition of sediment follows the retreat of the sea. Since the coarsest material is always deposited nearest to the shore and the finest silt and mud farthest from the shore, it follows that a retreating sea gives

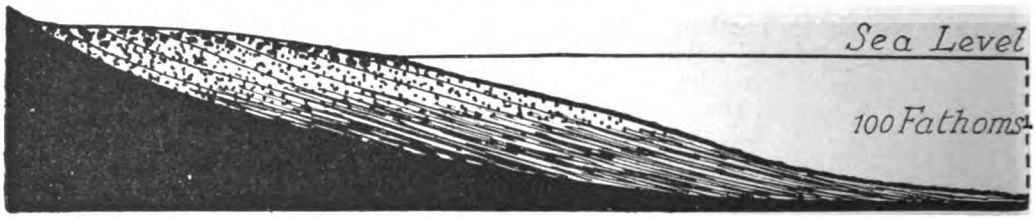


Fig. 45.—Section illustrating the formation of sediments on the continental shelf when the land is rising, or sea retreating.

a gradually widening deposit having the coarse gravel above, sand in an intermediate position, and silt and mud at the bottom (Fig. 45).

When the sea advances, the land forms already developed according to the degree of denudation will be partially submerged, and the new coastal forms will consequently depend on the former relief of the sunken land. Wide indentations and broad bays are formed when a peneplane is invaded by the sea. The Great Australian Bight has so been formed by the sinking of the plateau of South Australia. When, however, a region of mountains and valleys is submerged, a more complex coast results. The valleys are now represented by bays, loughs, gulfs, lochs, firths, estuaries, vias, sounds, straits, etc. The high land between is responsible for capes, promontories, peninsulas, and outlying islands. The sea lochs and firths of Scotland, the sea loughs of Ireland, the estuaries of England, and the fiords of Norway are all the drained continuations of corresponding types of valleys.

In this case the zone of deposition follows the advance of the sea, and the coarse beach deposits are gradually buried beneath later more fine-grained sediments. Hence an advancing sea gives a slowly widening deposit having the coarse gravel below, sand in an intermediate position, and silt and mud at the top (Fig. 46).

Classification of Marine Deposits.—All the detrital sediment which is carried by rivers and wind into the sea, and much of the material carried in solution, is deposited on the ocean floor. There are innumerable types of marine deposits, but all fall under two main headings. *Terrigenous* deposits are made up of the waste of adjoining land, and with them are associated the remains of organisms (e.g. such as are responsible for most limestones) which lived in the shallow seas of the continental shelf. *Pelagic* or *abyssal* deposits are the accumulated remains of calcareous and siliceous organisms which have lived in the ocean waters, and the hard parts of which have afterwards fallen to the bottom. With them are generally found traces of volcanic ash and dust, and of the dust of meteorites which have fallen through the atmosphere from interplanetary space.

According to their location, marine deposits fall into three groups. *Littoral* deposits are those formed between the levels of low and high tide, and cover a narrow ribbon-like area averaging half a mile in width all around the coasts. *Shallow water* deposits are those which collect on the continental shelf—i.e. from low water down to an average depth of 100 fathoms. Below this level all deposits are referred to as *deep sea* deposits.

Coral Reefs and Atolls.—In tropical regions, and especially in the Western Pacific and Indian Oceans, corals, calcareous algæ, and foraminifera, grow in such profusion as to build up reefs and islands sometimes of considerable size. The reefs may be *fringing* reefs, when they are in visible continuity with land not made of coral, or *barrier* reefs when they are separated from the land by a channel or lagoon. Coral islands, or *atolls*, are rings, generally broken, but sometimes complete, enclosing a shallow lagoon.

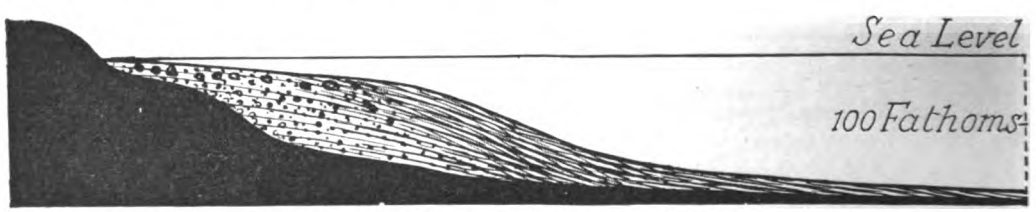


Fig. 46.—Section illustrating the formation of sediments on the continental shelf when the land is falling, or sea advancing.

Photo: Hibbott.

THE SUBMARINE FOREST OFF THE CHESHIRE COAST,

trees of which can be seen between Hoylake and Leasowe, testifies conclusively to a rise of sea level or a fall of the land.

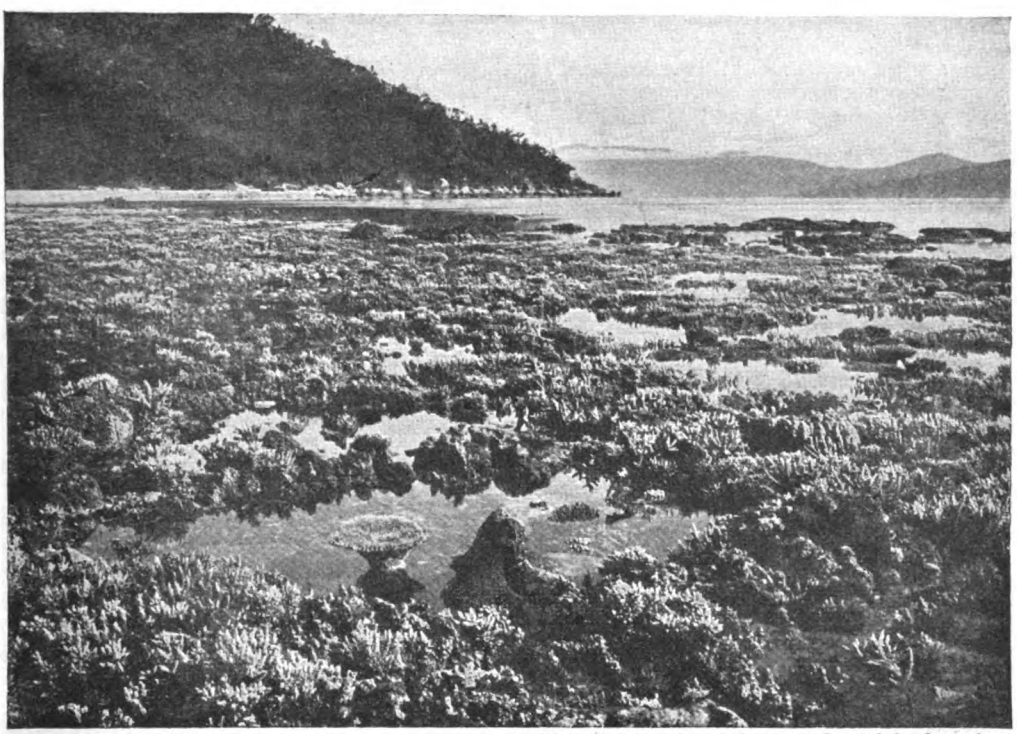


Photo by permission of the Agent General for Queensland.

CORAL REEF AT CAIRNS, QUEENSLAND.

The reef here shown is just above the level of low tide; corals cannot live after much exposure to the sun (*see also pp.* 145 *and* 146).

The formation of these structures is necessarily conditioned by the habits of the coral organism.

(*a*) Living coral does not grow above water, and consequently reefs and atolls never rise far above sea level. Broken coral and coral sands are thrown up by the waves, and in

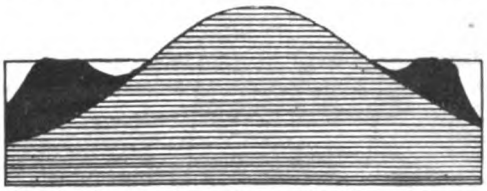


Fig. 47.—Barrier Reef.

this way a height of 10 feet or 20 feet may be reached. A coral reef at any higher level is therefore conclusive evidence of the withdrawal of the sea or of elevation of the sea floor.

(*b*) Corals require a temperature of at least 70° F., and reefs and atolls are therefore limited to a zone lying between latitudes 30° N. and 30° S., except where warm ocean currents carry that temperature farther north or south, e.g. the coral reefs of the Bermudas.

(*c*) Corals cannot grow freely below a depth of 30 fathoms, and consequently they

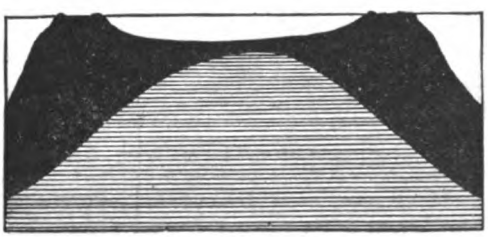


Fig. 48.—Atoll.

can only commence to build in waters limited by that depth.

(*d*) Corals grow best on the seaward sea, where the splashing waves and rising tides bring them fresh supplies of food. On the inside of reefs and atolls they die for want of food. It is clear, therefore, that the corals always tend to build outwards, *into* the sea and away from the older dead coral of the inside of atolls and of the landward side of reefs.

Opposite rivers which bring down mud in suspension they cannot live, and consequently reefs are never developed in such situations.

From the above facts the growth of a fringing reef will be easily understood. The corals, accompanied by other calcareous organisms, simply grow upwards and outwards from the floors of shallow seas (Fig. 48).

Barrier reefs and atolls, however, cannot be so easily explained; they rise from depths where no coral could live (Figs. 47, 49). There are only two possibilities: either the foundations have not been built by coral or, if the corals did build them, the sea has deepened since the period of their formation—i.e. either the ocean floor has sunk or the level of the sea has risen. Each of these explanations is probably correct, but neither will explain *all* reefs and atolls.

Darwin first proposed and Dana afterwards supported and developed the view that the ocean floor had subsided. All reefs, on this view, began as fringing reefs around the continents or islands. As subsidence continued, the corals grew outwards, always

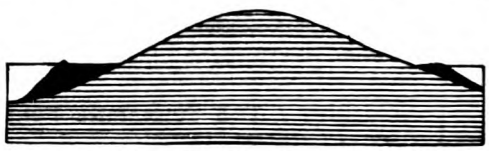


Fig. 49.—Fringing Reef.

keeping up to sea level, and thus between the mainland or island and the reef a lagoon gradually formed. Thus barrier reefs are explained. Carrying the subsidence a stage farther, the central island would ultimately be submerged and an atoll would result.

Murray and Agassiz believed, on the contrary, that subsidence need not be invoked on so gigantic a scale as the above theory demands. In the first place, fragments of dead coral accumulate on the seaward side of a fringing reef, and may in course of time build up a platform of debris to a level on which living corals can flourish. On the landward side the corals die, and solution, aided by boring organisms, removes the material, hollowing out a lagoon. Atolls can be formed in the same way, provided that submarine elevations reaching up to within 30 fathoms of the surface are present to give the corals a start. Now elevations of that kind could be produced in three ways:—

(*a*) Volcanic islands originally above the water would be worn down to sea level and below by marine denudation.

(*b*) Submarine volcanoes would in some cases just reach the required elevation, though this coincidence would, of course, be rare.

(*c*) Submarine volcanoes which did not reach the required elevation would be built

up by the accumulation of pelagic deposits until they reached a level at which colonies of coral could flourish.

Daly has recently made a further interesting contribution to the subject. He suggests that during the Pleistocene (glacial) period the level of the ocean would fall owing to the abstraction of the vast amount of water then spread over the lands as ice. Probably the cold then forbade any extensive growth of coral, and marine denudation would pare down earlier reefs and volcanic islands to below sea level. With the return of mild conditions the corals would again begin to flourish on the platforms so prepared for them, and as the depth of the sea gradually increased with the melting of the ice, so the corals grew upwards and outwards.

This theory has the advantage that it does away with the necessity of assuming *solution* for the formation of lagoons, and, in conjunction with Murray's view, it explains many of the features of barrier reefs and atolls quite satisfactorily. Nevertheless, there are still a few cases where subsidence appears necessary, and Darwin's view, though less applicable than he thought it to be, generally remains the most successful. A. H.

ANATOMY AND PHYSIOLOGY. XIV

We have now traced how the body machine is supplied with fuel and oxygen, and how it gets rid of carbon dioxide and also of some water by the lungs.

We have still to consider how the nitrogenous waste is disposed of, and also the water which is not lost in the breath.

Nitrogenous matter, salts and water are lost by way of the kidneys; water and some salts are lost by the skin.

We will take the kidneys first. We may consider that it is the function of the kidneys to remove from the body nitrogenous waste, salts and water. This is done by the secretion of urine.

If we examine urine we shall see what it is that the kidneys remove. Every day, in ordinary health and under average conditions of heat and cold, a grown-up man passes two and a half pints of water in a day. This is his urine.

Healthy urine is a clear yellow fluid; its colour depends on some colouring matter which comes from the liver. It contains nitrogenous waste in two chief forms, called urea and uric acid. Urine contains about 5 per cent. of solids.

Urea is a body consisting of carbon, hydrogen, oxygen and nitrogen, and is closely allied to ammonium carbonate. Ammonia is an alkali which will act as a base and form salts, of which ammonium carbonate is one.

In the breaking down of proteid which occurs in the body when work is being done, some ammonia and similar bodies are formed; these are highly poisonous. As the blood passes through the liver, the liver-cells act on this ammonia and change it into urea, which is comparatively harmless.

Expelling Nitrogen from the Body

Urea is present in small amounts in blood, and is removed from it by the kidneys. The total amount passed in urine is about an ounce a day. Its importance is that it is the chief way in which nitrogen is got rid of from the body, and since all proteid food contains nitrogen, so that a great deal is taken into the body every day, there must be some means of getting rid of it every day.

Uric acid is a body also containing nitrogen, and salts of uric acid are always present in small amount. Other salts are phosphates, sulphates and chlorides (combinations of the metals sodium, potassium, magnesium and calcium with phosphoric, sulphuric and hydrochloric acid). All these together amount to about another ounce a day.

Urine tested with litmus gives the acid reaction; the litmus turns red. This is due to *acid sodium phosphate*. When urine has stood for some time it often turns thick and cloudy, and people are sometimes alarmed about it. It is generally due to the precipitation of salts of uric acid, such as sodium urate, and if the urine is warmed it all dissolves again. There is no occasion for alarm.

We see, then, that every day two and a half pints of water are passed from the kidneys, which contains about two and a half ounces of solids. These solids are one ounce of urea, containing nitrogen, one ounce of salts, and half an ounce of colouring matter.

The kidneys are two organs placed at the back of the abdomen, one on each side of the spine. They are each about four inches long, and bean-shaped, or curved, with the convex side outwards and the concave inwards.

When split open they are seen to have a cavity inside a very thick wall. It can be seen also that they have an outer part or

cortex, and an inner part or *medulla*, which are different in structure. The inner part is gathered into " pyramids " or cones, which project into the cavity inside. The cavity consists of the intervals between the pyramids, called " calices," and a space called the " pelvis " of the kidney. The pelvis opens into a long tube called the ureter.

Each kidney is supplied by a large artery, the renal artery, from the abdominal aorta. Its branches pass and run along between cortex and medulla. From here branches run towards the outer edge of the kidney, and give off short branches all the way along. These last branches break up into little balls of capillaries, called " Malpighian capsules."

Anatomy of the Kidney

The kidney substance itself consists of masses of very winding tubes. These begin at the little balls of capillaries just mentioned; these balls appear to be thrust into the closed ends of the tubes. The tubes then form a loop which runs down into the medulla, and up again into the cortex, and then opens into another tube, called the *collecting tubule*, which runs straight downwards into the medulla and opens into the pelvis at the top of one of the pyramids.

There is a close network of blood vessels round the loops which come from the balls of capillaries first mentioned.

The tubules of the kidneys are lined by many different kinds of cells, thin and flat in the Malpighian capsules, and more elaborate in the loop. It is thought that the watery parts of the urine are filtered through the capsules, and that other bodies of the urine are actually secreted by the more complicated cells of the tubules. Possibly some of the water secreted by the capsules is reabsorbed by the tubules. At any rate, the function of the kidney is to get rid of urea, salts and water from the blood, and not to allow albumen to escape.

The urine leaves the pelvis of each kidney by passing into the ureter of each side. This is a tube of involuntary muscle and fibrous tissue which leads into the bladder, a muscular bag in the pelvis.

The ureters have the power of peristalsis, like the intestine, and as the urine is constantly being secreted, they continually pass it on into the bladder, where it accumulates. If there were no bladder there would be continual dribbling of urine out of the body, which would be very uncomfortable and inconvenient. The bladder will hold about a pint of water, and can be emptied at intervals of several hours.

The urinary bladder consists of involuntary muscle, and is an egg-shaped structure placed in the front of the pelvis. When it is empty it lies behind the pubic bones; when full it stretches upwards sometimes as high as the navel. The ureters enter its lower and back part on either side.

Its upper side or fundus is covered by peritoneum. Its muscle is arranged in three layers, the outer and inner being lengthwise, and the middle circular. It is lined by mucous membrane, which is two layers thick, thin flat cells above, with pear-shaped cells beneath them.

The urine escapes from the bladder into the urethra, by which it reaches the outside. This tube leads into the front passage, and is a long tube in the male, and short in the female. It consists of involuntary muscle and fibrous tissue, and is lined by mucous membrane. The outlet from bladder to urethra is controlled by a ring of muscle, the sphincter.

A Reflex Action

The act of passing water, or *micturition*, is what is called a *reflex*; we shall study reflexes with the nervous system.

The urine is continually being secreted by the kidneys. As the blood passes through the kidney, the kidney cells take from it water, urea, salts and colouring matter, and this urine is forced down the ureter by peristalsis, and collects in the bladder. The bladder can hold a certain amount of water without discomfort, about half a pint as a rule—it varies in different people; but when the amount gets greater the muscle fibres get stretched and the mucous membrane is irritated, and there is an uncomfortable feeling. The sensory nerves of the bladder are irritated, impulses pass up them to the spinal cord, and other impulses come down the motor nerves.

These impulses cause two things to happen: (1) the sphincter of the bladder is relaxed, and (2) the bladder itself contracts and squeezes the urine out along the urethra, till it escapes from the body. There is no air in the bladder, and the urine will not flow out even when the sphincter is relaxed, without real contraction of the bladder muscle.

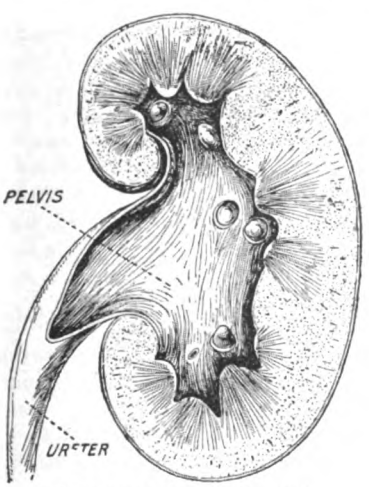
Water is also lost by the skin as sweat or perspiration. The skin is the tough leathery covering of the body. In many parts of the body, such as the neck, you can pick the skin up and pull it a little way off the parts it covers. It consists of two parts, the " true skin " or dermis, made chiefly

of fibrous tissue and containing nerves and blood vessels, and so it feels pain, and bleeds if cut. This is covered by the "scarf skin" or epidermis, which consists of several layers of cells, the top ones being only flattened scales which can be scratched off the surface without pain or bleeding.

The sweat glands are situated all over the skin; they consist of coiled tubes which dip down through the true skin and open on the surface. They secrete sweat, which consists chiefly of water containing 2 per cent. of salt and traces of other materials.

The object of this secretion by the skin is to keep the body temperature always the same. Heat is constantly being produced by the body when the muscles contract, but the body temperature keeps the same. If there were no sweating the body would lose heat in cool air, but it would not lose it quickly enough, and the temperature would rise.

The sweat is constantly being secreted,



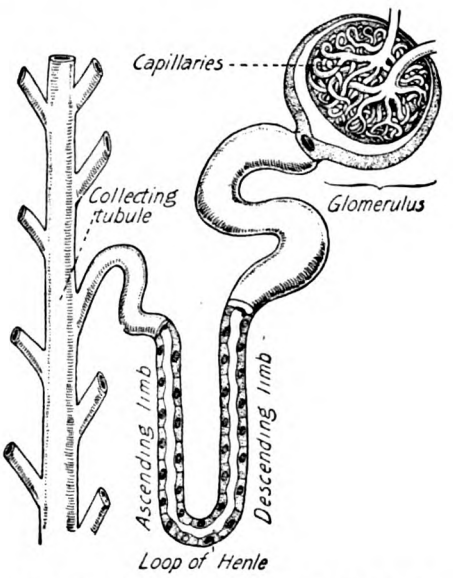
SECTION OF A KIDNEY,

an organ about 4 inches long and bean shaped. The two kidneys are placed at the back of the abdomen, one on each side of the spine, the concave side inwards.

as a rule only in small amounts, which evaporate or dry up as they are secreted; whenever evaporation takes place there is a loss of heat, and the surface on which the water dries up is cooled. We are not conscious of this slight sweating, and it is called "insensible perspiration." But when we are doing much muscular work, or when we are in a room with a hot fire, a greater heat loss is required, the skin sweats more freely and rapidly, and the "beads of perspiration" can be seen and felt.

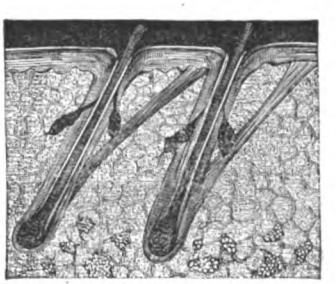
The activity of the sweat glands, and the amount of water secreted, is controlled by the nervous system.

This is the excretion of water by the skin. If on one day one drank three pints of water and stood about in the cold, most of



MINUTE ANATOMY OF THE KIDNEY.

the water would be excreted by the kidneys as urine; and if next day one drank the same amount, but ran about in a hot sun, the skin would secrete more and the kidneys less.



HAIRS, AND THE SEBACEOUS GLANDS

at the roots, which secrete a kind of grease to lubricate the skin.

Besides sweat glands there are also "sebaceous" glands at the roots of hairs which secrete a kind of grease.

Hair and nails are special developments of the epidermis.

The true skin also contains the ends of the sensory nerves, and so possesses the important sense of feeling on which so much of our power of adaptation to our surroundings depends. D. W. C.-J.

Continued from page 416.

LANGUAGES:

***Contributors*:**—LATIN, GREEK and FRENCH (E. A. Baker, M.A., D.Lit.). GERMAN (M. A. Lewenz, M.A.[Lond.]). SPANISH, RUSSIAN and ITALIAN (Alfred Calvert, First Prizeman in Modern Languages, R.S.A., London).

LATIN.—XXXIV

GREAT variety and freedom of expression are allowable in the use of moods and tenses in conditional clauses, and it will be sufficient here to set forth the most common and normal usages, further illustrations being given in the exercises.

Conditional Sentences

A conditional sentence consists essentially of two members, the dependent or *if*-clause, called the protasis, and the principal clause or hypothesis, called the apodosis. *If you do this, you will be wrong* is a conditional sentence in which the principal clause, *you will do wrong*, the apodosis, is conditioned by the subordinate qualifying clause, *if you do this*, the protasis.

From the grammatical subordination of the protasis, it follows that the mood and tense of the apodosis will regulate the mood and tense of the protasis. If the indicative be required in the apodosis, it must be used in the protasis; if, on the other hand, the subjunctive be required, this must be used also in the protasis. Further, if the subjunctive mood be employed, the tenses in each member must correspond, primary or secondary tenses being used in both clauses alike.

Indicative Mood

Three normal types of conditional sentence may be distinguished, according to the mood and tense of the verbs:—

(A) Indicative mood (or imperative).
(B) Subjunctive mood, primary tense.
(C) Subjunctive mood, secondary tense.

Let us take each type in turn.

(A) The indicative mood is usually employed when the conditional statement is treated as a fact, apart from the question whether the fact is actually realised or not. This is clearly altogether different from the meaning when the subjunctive is used, which mood implies that the events in question are mere imaginary suppositions.

A conditional sentence in the indicative may imply—

(1) That the events in question may or may not have occurred in the past;

(2) that they may or may not occur in the present; or

(3) that they may or may not occur in the future.

Thus we get statements of the following character:—

(1) Si hoc feci, peccavi.	*If I did this, I did wrong.*
(2) Si hoc facio, pecco.	*If I do this, I am doing wrong.*
(3) Si hoc faciam, } pec- Si hoc fecero, } cabo	*If I do this, I shall do wrong.*

Other tenses may be used, and different tenses in the protasis and the apodosis, if required by the meaning, thus—

Si propero, mox perveniam.	*If I hurry, I shall soon arrive.*
Si Faesulis erat, mox Romam veniet.	*If he was at Fiesole, he will soon come to Rome.*

Subjunctive Mood

(B) The future indicative is used, as we have just seen, when the condition is one that may or may not occur in the future. When, however, the reference to the future is of a vague kind, in other words when the occurrences are merely imaginary, but being in the future may be regarded as possible, though we do not anticipate that the possibility will be realised, then the verbs are put in a primary tense of the subjunctive. Accordingly we get sentences like the following, suggesting a less probable contingency than that suggested by the indicative:—

Si hoc faciam, peccem.	*If I were to do this* (or briefly, *if I did this*) *I should do wrong.*
Si hoc fecerim, peccem.	*If I should have done this* (or *if I should do*, or *if I did this*) *I should do wrong.*

(C) Imaginary suppositions referring to the present or past are expressed by secondary tenses of the subjunctive. Sentences in this form definitely imply that the supposition is not being or has not been realised. If it is regarded as not realised in the present, the imperfect should be used in both clauses.

Secondary Tenses

If it is regarded as not realised in the past, the imperfect may be used, but the more regular tense, in both clauses, is the pluperfect. Thus we get sentences of the following types, in which you will be careful to notice that the sentence using the imperfect may have two meanings, according as it refers to the present or the past :—

Si hoc facerem, peccarem. (of the present)	*If I were doing this* (or *did this*) *I should be doing wrong.*
Si hoc fecissem, peccassem, or Si hoc facerem, peccarem. (of the past)	*If I had done this, I should have done wrong.*

Extreme care must be taken to determine the exact meaning that it is intended to convey. As in so many other cases, already illustrated, Latin is much more precise than English in the statement of conditions and hypotheses, and it can be decided only from an observant study of the context, or from the clearest realisation of what the student himself wishes to express, whether a conditional sentence containing the English auxiliary *would* or *should* refers to the present or vaguely to the future.

Again, in the same way, it can be determined only by the same close attention whether a sentence with verbs in the imperfect, like the first and the third of the last group of three, refers to the present or the past. Latin has no means of marking this distinction of time internally, except by the insertion of adverbs like **nunc**, *now*, and **tum**, *then*.

With regard to the A group, note that in sentences referring to the future the future-perfect indicative is preferred to the simple future in the protasis, and the simple future to the future-perfect in the apodosis. Thus **si hoc fecero, peccabo** is to be preferred to **si hoc faciam, peccabo**, or **si hoc fecero, peccavero**, *If I do this I shall do wrong*, or *shall have done wrong*.

Note also that the imperfect and the pluperfect are often found in the same sentence, and other deviations occur occasionally from the types of sentences quoted. Thus we may find a sentence of the form **si vixisset, regnaret**, *if he had continued alive, he would be reigning.*

The imperative may be used instead of the indicative in sentences of the A type :—

Si vultis evadere, statim fuge.
If you wish to escape, flee at once.

The *if*-clause is not always formally expressed in what is yet essentially a conditional sentence. Sometimes the condition is merely understood, or it may be expressed by an adverb or an adverbial clause, as in the following, the subjunctive in what is virtually the apodosis of a conditional sentence giving the key to the hypothetical nature of the statement :—

Rege mortuo, filius potestatem adipiscatur.
Were the king dead his son would succeed.
Libenter fecissem.
I would gladly do it.

The Conditional Conjunctions are **sī**, *if*, **sīvĕ, seu**, *or if*, **dum**, *provided that*, **mŏdŏ**, *provided*, **nĭsĭ, nī**, *unless*, **sī nōn**, *if not*, **sīn**, *but if*, etc. Alternative conditions are introduced by **sīvĕ...seu** (or **seu...seu**), and must be carefully distinguished from **ŭtrum...ăn**, which introduce alternative questions, and **aut...aut**, which connect disjunctively two co-ordinate clauses.

Exercise 33

Translate into English :—

1. A philosopho, si afferat eloquentiam, non asperner, si non habeat, non flagitem. 2. Si mihi probabis ea quae dices, libenter tibi assentiar. 3. Si ea sola voluptas esset, quae ad sensus cum suavitate afflueret, ut ita dicam, nulla corporis pars vacuitate doloris sine iucundo motu voluptatis contenta esse posset. 4. Sin autem, summa voluptas est, ut Epicuro placet, nihil dolere, primum tibi recte concessum est, nihil desiderare manum, cum ita esset affecta. 5. Si vita doloribus referta maxime fugienda est, summum profecto malum est vivere cum dolore. 6. Epicurus autem "Virtutem," inquit, "nisi voluptatem efficeret, quis expetendam arbitraretur ?"

Translate into Latin :—

1. If you ask me, I shall be delighted to come to dinner with you to-morrow. 2. I will do it if I can. 3. When I have taken the city I shall return. 4. If I were to deny that I am influenced by regret for my friend, I should certainly be speaking untruth. 5. If he wished him to set fire to the temple, he would think it ought to be done. 6. It is difficult for friendship to be maintained if you fail in virtue.

Key to Exercise 32

1. It would be tedious to tell you everything. 2. It would have been better to say so at once. 3. He might easily have escaped, but he would not make the attempt. 4. Could he not in his hour of triumph have shown mercy to me the friend of his youth ? 5. Now those men are worthy of friendship who have in them some reason for being loved. 6. They love those most of all from whom they hope to gain the most advantage.

1. Omnia quae sibi erant mihi dedit. 2. Qui sapientiam habeant divites sunt. 3. Una res quae nobis nunquam deficere potest exstat virtus. 4. Quae cuperet illi me daturum esse sum pollicitus. 5. Negavi, quia ea quae cuperem mihi dare nollent. 6. Multi ea tantum quibus ipsi non egent aliis dant. E. A. B.

RUSSIAN.—XXIII

VOCABULARY

металли́ческія изде́лія, *metal goods.*
ввози́мый, *imported.*
наконе́цъ, *finally.*
въ отноше́ніи, *respecting.*
ору́дія, *implements.*
составля́ющій, *forming.*
включа́ть, *to include.*
ви́дѣть включёнными, *to see included.*
сле́дующее, *the following.*
дабы́, *in order to.*
получа́ющій, *taking.*
получа́емый, *received.*
приходи́ть, *to come.*
ука́занный, *stated.*
пропо́рція, *proportion.*
а и́менно, *viz., namely.*
А́нглія, *England, United Kingdom.*
фигу́ра, *figure.*
становиться, *to be, become.*
вполнѣ́ я́снымъ, *very evident.*
далеко́ впере́ди́, *far ahead.*
бы́вши, *behind.*
са́мымъ кру́пнымъ, *the greatest.*
экспортёръ, *exporter.*
въ отноше́ніи, *in relation to.*
приложи́ть стара́нія, *to endeavour.*
къ увеличе́нію, *to increase.*
экспо́ртное проце́нтное отноше́ніе, *percentage of exports.*
дабы́ опереди́ть, *to take the lead.*
баго́вольте, *will you kindly.*

СТАТЬЯ́ ДЛЯ ЧТЕ́НІЯ

Ма́нчестерская Экспо́ртная Конто́ра. (Продолже́ніе).

1.

1. Незадо́лго до наступле́нія Вели́кой Европе́йской Войны́ въ 1914 году́ нашъ вы́возъ въ Россію и нашъ ввозъ въ Россію постепе́нно достига́ли значи́тельныхъ разме́ровъ.

2.

2. Торго́вля ме́жду Великобрита́ніей и тѣмъ обши́рнымъ Госуда́рствомъ постепе́нно станови́лась всё бо́лѣе ва́жной, а при до́лжномъ внима́ніи могла́ бы разви́ться почти́ до безконе́чныхъ преде́ловъ.

3.

3. Ка́ждому коммерса́нту, име́ющему торго́выя сноше́нія съ Россіей, навѣрно́е бу́детъ интере́сно име́ть пе́редъ собо́ю въ сокращённой фо́рмѣ пере́чень главне́йшихъ това́ровъ, вы́везённыхъ изъ той страны́ и ввезённыхъ туда́ въ 1913 году́, вмѣстѣ съ ихъ приблизи́тельной цѣ́нностью.

4.

4. Въ томъ году́ Великобрита́нія вы́везла въ Россію: каме́нный у́голь, маши́ны, и желѣ́зо въ обрабо́танномъ и необрабо́танномъ ви́дѣ, ка́ждый цѣ́нностью отъ одного́ до двухъ милліо́новъ фу́нтовъ сте́рлингъ; се́льдей, шерсть, шерстяны́я изде́лія, и ка́мвольную пря́жу, хлопча́то-бума́жныя изде́лія и бума́жную пря́жу, ору́дія и инстру́менты, мѣдь въ обрабо́танномъ и необрабо́танномъ видѣ, свине́цъ въ сви́нкахъ и изде́ліяхъ и хими́ческія вещества́, ка́ждый цѣ́нностью отъ ста тысячъ до одного́ милліо́на фу́нтовъ сте́рлингъ.

5.

5. Въ свою́ о́чередь Россія вы́везла въ Великобрита́нію за тотъ же са́мый годъ: строево́й лѣсъ, овёсъ, ячме́нь, лёнъ и па́клю, нефть, ма́сло и я́йца, ка́ждый цѣ́нностью отъ одного́ до пяти́ милліо́новъ фу́нтовъ сте́рлингъ; ру́бленный лѣсъ, пшени́цу до четырёхъ милліо́новъ фу́нтовъ сте́рлингъ; кукуру́зу, льня́нныя сѣмена́, коно́плю, ка́мни, лошаде́й, щети́ну, горо́хъ, бума́жную и древе́сную ма́ссу, пти́цу и дичь, ко́зьи шку́рки и маргане́цевую ру́ду́, ка́ждый отъ ста ты́сячъ до одного́ милліо́на фу́нтовъ сте́рлингъ.

READING EXERCISE

A Manchester Shipping House (*continued*)

1.

For some time previous to the outbreak of the Great European War in 1914, our exports to Russia and our imports from that country had gradually reached considerable dimensions.

2.

The trade between Great Britain and that immense State has been gradually increasing in importance, and, with proper handling, might be developed almost indefinitely.

3.

It will certainly be of interest to every business man trading with Russia to have placed before him in a concise form a list of the principal articles exported to and imported from that country, together with their approximate values for the year 1913.

4.

That year Great Britain sent to Russia: coal, machinery, and iron wrought and unwrought, each between £1,000,000 & £2,000,000; herrings, wool, woollen goods and worsted yarns, cottons and cotton yarns, implements and tools, copper wrought and unwrought, lead (pig and manufactured), and chemicals, each between £100,000 and £1,000,000.

5.

On the other hand, Russia exported to Great Britain in the same year: sawn timber, oats, barley, flax, and tow, naphtha, butter, and eggs, each between £1,000,000 & £5,000,000; hewn timber, wheat up to £4,000,000, maize, linseed, hemp, stones, horses, bristles, peas, paper and wood pulp, poultry and game, goatskins and manganese ore, each between £100,000 and £1,000,000.

6.

Россія ввезла въ 1913 году:

	Стоимость въ милліонахъ рублей
Машины и части машинъ	121
Сырой хлопокъ	114
Каменный уголь и коксъ	87
Шерсть	64
Земледѣльческія орудія	37
Сельдей и другія рыбы	37
Чай	31
Химическія издѣлія и аптекарскія принадлежности	25
Семена и растенія	27
Кареты, велосипеды и автомобили	22
Обработанныя кожи	21
Необработанныя кожи	21
Вина	20
Шерстяную пряжу	19
Желѣзныя и стальныя издѣлія	19
Красящія вещества и краски	15
Шерстяныя издѣлія	15
Рисъ	13
Желѣзную посуду, ножевой товаръ и инструменты	13
Свинецъ въ свинкахъ и листахъ	13
Олово въ брускахъ и прутках	12
Мѣдь, аллюминій, никкель	12
Сало	12
Сырой джутъ	12
Бумажную пряжу	10
Кофе	10
Издѣлія изъ мѣди	10
Дубильныя вещества	10
Цинкъ въ брускахъ и листахъ	6
Проволочныя издѣлія	6
Цементъ и глины	6
Кожаныя издѣлія	6
Льняныя и пеньковыя издѣлія	5
Суда, буксирные приборы и землечерпательныя машины	5
Москательные товары	4
Чугунныя издѣлія	4
Огнеупорные кирпичи и черепицы	3

6.

Russia imported in 1913:

	Value in million roubles
Machinery and machinery parts	121
Raw cotton	114
Coal and Coke	87
Raw wool	64
Agricultural implements	37
Herrings and other fish	37
Tea	31
Chemicals and drugs	25
Seeds and plants	27
Carriages, bicycles, motor-cars	22
Dressed leather	21
Undressed leather	21
Wine	20
Wool yarns	19
Articles of iron and steel	19
Dyestuffs and paints	15
Woollen manufactures	15
Rice	13
Hardware, cutlery, and hand tools	13
Lead, pigs and sheets	13
Tin, bars and rods	12
Copper, aluminium, nickel	12
Tallow	12
Raw jute	12
Cotton yarns	10
Coffee	10
Copper, worked	10
Tanning materials	10
Zinc in bars and sheets	6
Wire, worked	6
Cements and clays	6
Leather goods	6
Flax and hemp, manufactured	5
Ships, tugs, dredgers	5
Spices	4
Cast iron, worked	4
Firebricks and tiles	3
Сырой чугунъ	3
Накладныя товары и ювелирныя издѣлія	3
Raw cast iron	3
Plateware and jewellery	3

7.

Россія вывезла въ 1913 году:

	Милліоны рублей
Питательныя вещества	590
Лѣсной товаръ	163
Яйца	90
Лёнъ	87
Масло	71
Нефть и произведенія	48
Хлопчато-бумажные товары	43
Мѣха и шкурки	35
Сахаръ	26
Сырыя шкуры	25
Марганцевую руду	14
Платину	14
Лошадей	13
Полевую рѣпу	10
Льняное сѣмя	10
Шерсть	10
Рогатый скотъ	10
Щетину	8
Птицу и дичь	8
Паклю	7
Табакъ	7
Спиртъ	5
Икру	5
Металлическія издѣлія	5
Резиновыя издѣлія	5
Желѣзную руду	3
Конскій волосъ	3
Рыбу свѣжую, копчёную, и солёную	3

7.

Russia exported in 1913:

	Million roubles
Foodstuffs	590
Timber	163
Eggs	90
Flax	87
Butter	71
Naphtha and products	48
Cotton goods	43
Furs and skins	35
Sugar	26
Raw hides	25
Manganese ore	14
Platinum	14
Horses	13
Rape seed	10
Linseed	10
Wool	10
Cattle	10
Bristles	8
Poultry and game	8
Tow	7
Tobacco	7
Spirits	5
Caviar	5
Metal goods	5
India-rubber goods	5
Iron ore	3
Horsehair	3
Fish, fresh, smoked salted	3

8.

8. По ввозу въ Россію за 1913 годъ Германія доставила 37%, Великобританія 22%, Франція 5½%, а Соединённые Штаты 7½%.

8.

To the Russian imports in 1913 Germany contributed 37 per cent., Great Britain 22 per cent., France 5½ per cent., and United States 7½ per cent.

По вывозу изъ Россіи въ томъ же самомъ году 27% пошло въ Германію, 20% въ Великобританію, 9% во Францію, а 9% въ Голландію.

Of the exports in the same year 27 per cent. went to Germany, 20 per cent. to Great Britain, 9 per cent. to France, and 9 per cent. to Holland.

9.

9. Для лицъ коммерческихъ сферъ было бы важнымъ изучать вышеуказанныя процентныя отношенія и насколько они бы могли быть увеличены въ пользу Англіи.

9.

It is worth the while of the commercial community to study how far the percentages shown above might be increased in favour of the United Kingdom.

Exercise 34

1. Имѣемъ надѣжду, что на́ша комме́рція съ Россіей пост не́нно увели́чится съ го́да въ годъ.

2. Незадо́лго до объявле́нія войны́ ме́жду Центра́льными и Сою́зными Госуда́рствами, брита́нскій вы́возъ въ Россію и ввозъ изъ нея́ ма́ло по ма́лу достига́ли значи́тельныхъ разме́ровъ.

3. При до́лжномъ внима́ніи торго́вля ме́жду А́нглі́ей и но́вой Ру́сской Респу́бликой (пре́жней импе́ріей) могла́ бы быть ра́звита почти́ до безконе́чности.

4. Наступле́ніе Вели́кой Европе́йской Войны́ въ 1914 году́ положи́ло коне́цъ вся́кой торго́влѣ ме́жду Герма́ніей (включи́тельно А́встріи, Булга́ріи и Ту́рціи) и Россіей.

5. Таково́е обстоя́тельство должно́ бы́ло дать Великобрита́ніи возмо́жность обезпече́нія за собо́ю значи́тельной ча́сти торго́вли, кото́рая до сихъ поръ была́ произведена́ Центра́льными Госуда́рствами.

6. Россія представля́етъ собо́ю обши́рный ры́нокъ съ вели́кой бу́дущностью и ру́сскіе лю́ди о́чень хорошо́ располо́жены къ ихъ сою́зникамъ, такъ что послѣдніе поста́влены въ о́чень благопрія́тномъ положе́ніи для разви́тія своей торго́вли съ э́тимъ грома́днымъ госуда́рствомъ.

7. Среди́ предме́товъ вы́везенныхъ Великобрита́ніей въ Россію, мы нахо́димъ маши́ны, желѣзо, и ка́менный у́голь.

8. Затѣмъ мы замѣча́емъ хлопча́то-бума́жныя издѣ́лія и бума́жную пря́жу, шерсть, шерстяны́я издѣ́лія и ка́мвольную пря́жу, мѣдь, ору́дія и инстру́менты, свине́цъ, хими́ческія издѣ́лія и се́льдей.

9. Изъ предме́товъ, кото́рые мы вво́зимъ въ Великобрита́нію изъ Россіи, главнѣ́йшіе изъ нихъ суть : строево́й и ру́бленный лѣсъ, хлѣба́, то есть, пшени́ца, овёсъ, ячме́нь и кукуру́за, и сыры́е матерья́лы, какъ-то : лёнъ, пе́нька, щети́на.

10. Мы та́кже получа́емъ изъ Россіи марга́нцевую руду́, бума́жную и древе́сную ма́ссу, льняно́е сѣмя, нефть, ко́зьи шку́рки, лошаде́й, горо́хъ, ма́сло и я́йца, пти́цу и дичь.

11. Въ приложе́ніи найдёте кра́ткій спи́сокъ главнѣ́йшихъ предме́товъ, вы́везенныхъ въ Россію и вы́везенныхъ изъ нея́ съ ихъ сто́имостью въ милліо́нахъ рубле́й и́ли въ фу́нтахъ сте́рлингъ.

12. Ка́ждому ру́сскому и брита́нскому коммерса́нту навѣ́рное бу́детъ о́чень интере́сно имѣ́ть предъ собо́ю всѣ э́ти подро́бности въ кра́ткой фо́рмѣ.

13. Да́йте намъ, пожа́луйста, подро́бности това́ровъ по́сланныхъ Великобрита́ніей въ Россію въ 1913 году́, а та́кже предме́товъ, вы́везенныхъ Великобрита́ніей изъ той страны́ въ томъ же году́.

14. Одновреме́нно съ тѣмъ Вы бы могли́ соста́вить для насъ спи́сокъ гла́вныхъ това́ровъ, соста́вившихъ весь о́бщій ру́сскій вы́возъ и ввозъ въ сноше́ніяхъ со всѣмъ ми́ромъ за тотъ періо́дъ.

Exercise 35

1. There is no reason why our trade with Russia, if properly handled, should not develop indefinitely.

2. Of the principal goods exported by Russia, Great Britain takes some 20 per cent. (figures to be written in Russian), consisting of foodstuffs, flax, timber, sugar, butter, cotton goods, raw hides, naphtha and products, manganese ore, horses, eggs, platinum, and seeds.

3. Continuing this list of Russian general exports we have furs and skins, cattle, poultry and game, wool, bristles, tobacco, and caviar.

4. To conclude the list, we should mention spirits, india-rubber goods, iron ore, fish, metal goods, and horsehair.

5. Among the articles imported by Great Britain from Russia are oats, maize, timber, butter, eggs, linseed, horses, naphtha, barley, and peas.

6. We have, finally, manganese ore, flax, poultry and game, paper and wood pulp, wheat, hemp, tow, and goatskins.

7. Respecting the articles exported by Great Britain to Russia, the principal ones are chemicals, machinery, implements and tools, coal, herrings, iron, woollen goods and worsted yarn, copper, wool, cotton goods and cotton yarn, and lead.

Key to Exercise 27

1. На основа́ніи Ва́шихъ регуля́рныхъ зака́зовъ, смѣ́емъ Васъ запроси́ть, почему́ Вы не удосто́или насъ Ва́шими извѣстія́ми такъ до́лго ? 2. Семе́йныя обстоя́тельства всѣ вре́мя отвлека́ли моё внима́ніе отъ дѣлъ. 3. Обраща́емъ Ва́ше внима́ніе на на́шу но́вую маши́ну шестьсо́тъ пятьдеся́тъ девя́ть. 4. Просма́тривая Вашъ счётъ, мы нахо́димъ, что Вы ещё не присла́ли намъ покры́тія за Янва́рскую отпра́вку. 5. Въ виду́ предстоя́щихъ крупныхъ платеже́й мы вы́нуждены проси́ть Васъ присла́ть намъ дѣсять семна́дцать фу́нтовъ. слѣ́дуемыхъ съ Васъ съ Ма́рта. 6. Благодари́мъ Васъ за при́сланный перево́дъ. 7. Тре́бующіяся Вамъ но́меръ се́мьдесятъ семь не имѣ́ется на скла́дѣ.

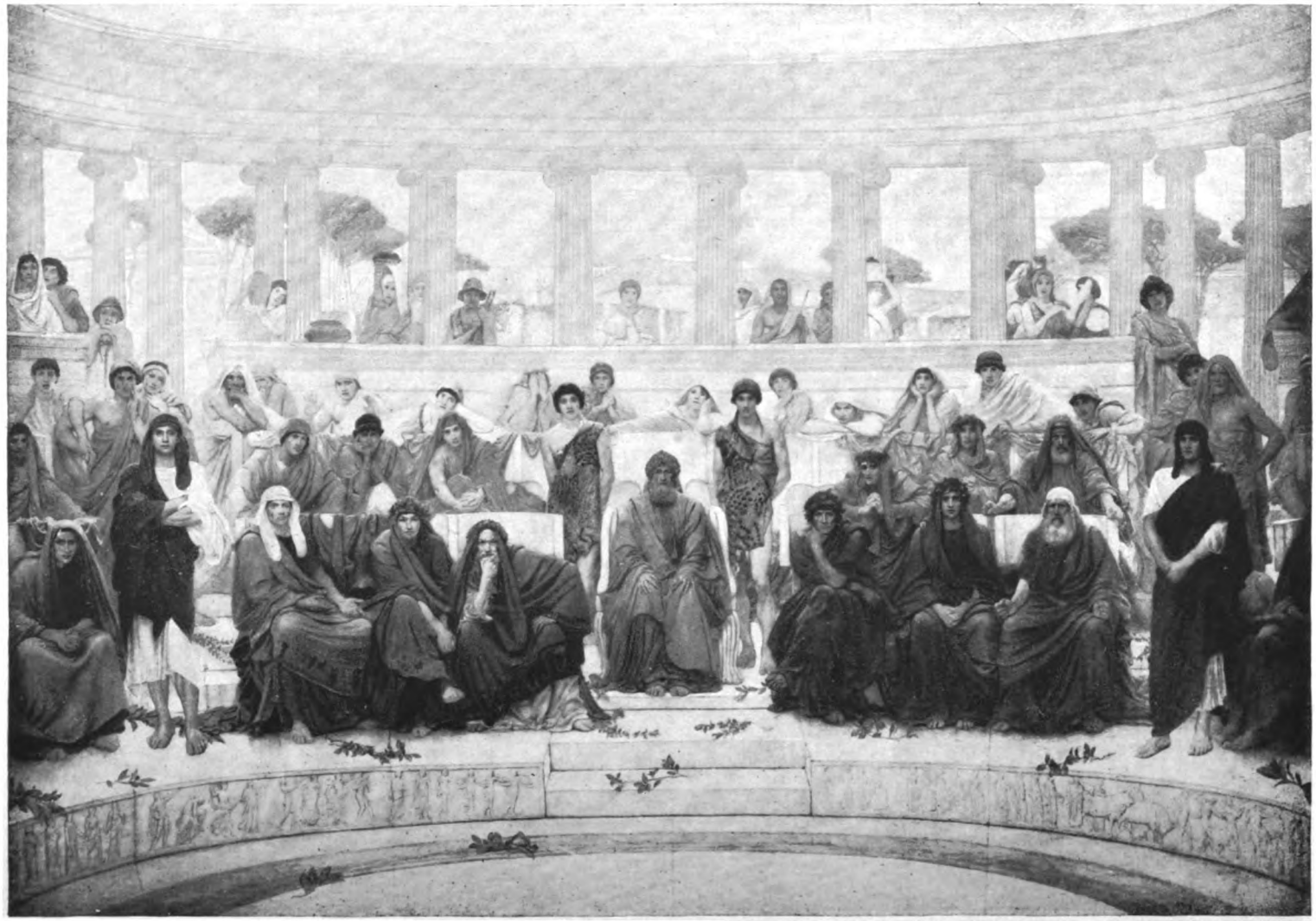
Key to Exercise 28

1. You ask me why we buy little of English goods ? 2. We are buying a fairly large amount (much) of English goods, but we receive them through third parties (second hands). 3. Why do you not order direct from England ? 4. In the first place the duty in many cases is too high. 5. Then, the great (far) distance hinders much our closer acquaintance. 6. But we have representatives in Russia. 7. The number of your representatives is very insufficient. 8. Against (for) that we are periodically sending you our travellers. 9. This would have been all right (good) if your travellers knew the Russian language well, but resorting to (the use of) interpreters is very wearisome and downright unprofitable. 10. This hindrance will soon be removed. Will it advance the Anglo-Russian relations any farther ?

Key to Exercise 29

1. Разъ Вы согласи́тесь дава́ть намъ подходя́щій для на́шего ры́нка това́ръ, счита́ть намъ крайнѣ́йшія цѣны и допуска́ть до́лгіе креди́ты, мы, коне́чно дади́мъ Вамъ преиму́щество. 2. А зна́ете ли Вы, что есть въ Россіи такіе проходи́мцы, кото́рые, не смотря́ на бди́тельность Ва́шихъ зако́новъ, успѣва́ютъ одна́кожъ жить чи́стымъ грабежо́мъ подъ ма́ской креди́та? 3. Я зна́ю нѣсколько примѣ́ровъ, гдѣ́ довѣрчивые англича́не си́льно пострада́ли чрезъ э́ти на́глые грабежи́. 4. Банкро́тства случа́ются въ ка́ждой странѣ́ ка́ждый день, а всё тако́й торго́вый міръ не воздержи́вается отъ предоставле́нія свѣ́жихъ креди́товъ. 5. Хра́брость необходи́ма не то́лько на по́лѣ би́твы, но та́кже и въ коммерческихъ предпрія́тіяхъ. Современная гига́нтская междунаро́дная торго́вля не была́ со́здана тру́сами. 6. Пра́вда, креди́тъ есть арте́рія торго́вли, но то́лько тогда́, когда́ онъ основанъ на благосостоя́ніи и благонаме́ренности обѣ́ихъ торгу́ющихъ сторо́нъ.

A. C.



From the picture by Sir W. B. Richmond, R.A., by permission of the Art Gallery Committee of the Corporation of Birmingham.

AN AUDIENCE AT ATHENS WITNESSING THE *AGAMEMNON*,

the first of the series of three plays, known as the *Oresteia*, written by Æschylus, the great Greek dramatist, who died B.C. 456. The picture shows the audience at the tense and emotional moment when Clytemnestra describes the killing of Agamemnon.

GREEK.—X

THE student will have noticed that the present stem and the tense-stems need to be distinguished apart, and also that in some verbs the present stem differs from the simple stem (sometimes called the verbal stem) which is the more primitive. In the preponderant class, verbs with vowel stems, such as λύω or βουλεύω, the present and the simple stem are identical. But even when the same stem reappears throughout the tenses it appears in various modified forms. Λύω is a verb with a simple stem λυ-, which appears with modifications of vowel-length in all tenses. In φαίνω, on the other hand, the simple stem φαν- appears in the future and elsewhere, and in modified forms as φην-, πεφαν-, φανθε-, φανε-, and φανησ-. In λείπω, the simple stem λιπ- appears in the second aorist, and in a modified form as λελοιπ-, and the following tense-stems also occur, λειψ-, λελειπ-, and λειφθε-.

Formation of the Tenses

We can here summarise all the existing tense-stems of these four verbs.

Simple Stems	λυ-	λιπ-	πραγ-	φἄν-
Present	λυ-	λειπ-	πρασσ-	φαιν-
Future	λυσ-	λειψ-	πραξ-	φανε-
First Aorist	λυσ-		πραξ-	φην-
Perfect Middle	λελυ-	λελειπ-	πεπραγ-	πεφἄν-
Perfect Active	λελυκ-		πεπραχ-	πεφαγκ-
Second Perfect		λελοιπ-	πεπραγ-	πεφην-
Future-Perfect	λελύσ-	λελειψ-	πεπραξ-	
Second Aorist		λἴπ-		
First Aorist Passive	λὔθε- (λυθη-)	λειφθε- (λειφθη-)	πραχθε- (πραχθη-)	φανθε- (φανθη-)
First Future Passive	λὔθησ-	λειφθησ-	πραχθησ-	
Second Aorist Passive				φἄνε- (φἄνη-)
Second Future Passive				φἄνησ-

The personal terminations may be summarised as follows:—

ACTIVE VOICE

	Primary Tenses			*Secondary Tenses*		
	1st	2nd	3rd	1st	2nd	3rd
Sing.	-μι or –	-ς (-σι)	-σι (-τι) or –	-ν or –	-ς	–
Dual		-τον	-τον		-τον	-την
Plur.	-μεν (-μες)–	-τε	-νσι (-ντι)	-μεν (-μες)	-τε	-ν or -σαν

PASSIVE AND MIDDLE VOICES

	Primary Tenses			*Secondary Tenses*		
	1st	2nd	3rd	1st	2nd	3rd
Sing.	-μαι	-σαι	-ται	-μην	-σο	-το
Dual		-σθον	-σθον		-σθον	-σθην
Plur.	-μεθα	-σθε	-νται	-μεθα	-σθε	-ντο

We may now take a general view of the Greek verbs of the first conjugation.

GENERAL CONSPECTUS OF THE GREEK VERB IN ω

ACTIVE VOICE

	Indic.	*Subj.*	*Optative.*	*Imper.*	*Infin.*	*Part.*
Pres.	λύω	λύω	λύοιμι	λῦε	λύειν	λύων
Imp.	ἔλυον					
Fut.	λύσω		λύσοιμι		λύσειν	λύσων
1 *Aor.*	ἔλυσα	λύσω	λύσαιμι	λῦσον	λῦσαι	λύσας
1 *Perf.*	λέλυκα	λελύκω	λε- λύκοιμι	λέλυκε	λε- λυκέναι	λελυκώς
1 *Plup.*	ἐλελύκη					
2 *Perf.*	πέφηνα	πεφήνω	πεφή- νοιμι	πέφηνε	πεφηνέ- ναι	πεφηνώς
2 *Plup.*	ἐπεφήνειν					
2 *Aor.*	ἔλιπον	λίπω	λίποιμι	λίπε	λιπεῖν	λιπών

MIDDLE VOICE

Pres.	λύομαι	λύωμαι	λυοίμην	λύου	λύεσθαι	λυόμενος
Imp.	ἐλυόμην					
Fut.	λύσομαι		λυσοίμην		λύσεσθαι	λυσόμενος
1 *Aor.*	ἐλυσάμην	λύσωμαι	λυσαίμην	λῦσαι	λύσασθαι	λυσάμενος
Perf.	λέλυμαι	λελυμένος ὦ	λελυμένος εἴην	λέλυσο	λελύσθαι	λελυμένος
Plup.	ἐλελύμην					
2 *Aor.*	ἐλιπόμην	λίπωμαι	λιποίμην	λιποῦ	λιπέσθαι	λιπόμενος

PASSIVE VOICE

1 *Aor.*	ἐλύθην	λυθῶ	λυθείην	λύθητι	λυθῆναι	λυθείς
1 *Fut.*	λυθήσομαι		λυθησοίμην		λυθήσεσθαι	λυθησόμενος
Fut.-per.	λελύσομαι		λελυσοίμην		λελύσεσθαι	λελυσόμενος
2 *Aor.*	ἐφάνην	φανῶ (φανέω)	φανείην	φάνηθι	φανῆναι	φανείς
2 *Fut.*	φανήσομαι		φανησοίμην		φανήσεσθαι	φανησόμενος

Certain exceptional forms in the conjugation of the perfect and pluperfect tenses remain to be enumerated.

The characteristic of the perfect tense in the active voice is reduplication, but in verbs beginning with two consonants (except a mute and a liquid) a double consonant, or ρ, the syllabic augment ε is used instead of reduplication: examples, στέλλω, *send*, ἔσταλκα, *I have sent*; σπείρω, *I sow*, ἔσπαρκα, *I have sown*; ῥίπτω, *I throw*, ἔρριφα, *I have thrown*; but γράφω, *I write*, γέγραφα, *I have written*. Some verbs beginning with a mute and a liquid, including those beginning with γν, take the syllabic augment instead of reduplication, as γνωρίζω, *I examine*, ἐγνώρικα, *I have examined*; γιγνώσκω, *I know* (stem γνω-), ἔγνωκα, *I have perceived*.

In verbs beginning with a short vowel this has the temporal augment: examples, ἀγγέλλω, *I announce*, ἤγγελκα, *I have announced*; ὀρθόω, *I raise up*, ὤρθωκα, *I have raised up*, ὤρθωμαι, *I am set up* or *restored*.

The pluperfect in these cases takes no further augment; examples, ἐστάλκη, *I had sent*, ἠγγέλκη, *I had announced*.

In the passive and middle voices the passive is formed by prefixing the augment (reduplicative or temporal) and adding μαι, etc., to the stem, thus λέλυμαι λέλυσαι λέλυται λέλυνται or in the pluperfect μην, etc., as in ἐλελύμην, ἐλέλυντο,

etc. The formation of these tenses is perfectly simple in the case of verbs with vowel-stems.

With stems ending in a consonant various euphonic changes occur.

The endings *νται* and *ντο* are not used with consonant stems in the third person plural which is formed by the perfect participle and *εἰσί*, *they are*, or *ἦσαν*, *they were*, present and imperfect of *εἰμί*, *I am*; examples, *πεπεισμένοι εἰσί* or *ἦσαν*, *they have* or *had been persuaded*; *ἠγγελμένοι εἰσί* or *ἦσαν*, *they have* or *had been announced*.

Before terminations beginning with *μ*, *σ*, *τ*, or *σθ*, a final mute of the stem is modified in the ways illustrated in the following perfect and pluperfect tenses of *γράφω*, *I write* (stem *γραφ*), *πλέκω* (stem *πλεκ*), *I weave*, and *πείθω* (stem *πειθ*), *I persuade*:

PERFECT INDICATIVE

Sing.	1.	*γέγραμμαι*	*πέπλεγμαι*	*πέπεισμαι*
	2.	*γέγραψαι*	*πέπλεξαι*	*πέπεισαι*
	3.	*γέγραπται*	*πέπλεκται*	*πέπεισται*
Dual	2.	*γέγραφθον*	*πέπλεχθον*	*πέπεισθον*
	3.	*γέγραφθον*	*πέπλεχθον*	*πέπεισθον*
Plur.	1.	*γεγράμμεθα*	*πεπλέγμεθα*	*πεπείσμεθα*
	2.	*γέγραφθε*	*πέπλεχθε*	*πέπεισθε*
	3.	*γεγραμμένοι εἰσί(ν)*	*πεπλεγμένοι εἰσί(ν)*	*πεπεισμένοι εἰσί(ν)*

PLUPERFECT INDICATIVE

Sing.	1.	*ἐγεγράμμην*	*ἐπεπλέγμην*	*ἐπεπείσμην*
	2.	*ἐγέγραψο*	*ἐπέπλεξο*	*ἐπέπεισο*
	3.	*ἐγέγραπτο*	*ἐπέπλεκτο*	*ἐπέπειστο*
Dual	2.	*ἐγεγράφθον*	*ἐπεπλέχθον*	*ἐπεπείσθον*
	3.	*ἐγεγράφθην*	*ἐπεπλέχθην*	*ἐπεπείσθην*
Plur.	1.	*ἐγεγράμμεθα*	*ἐπεπλέγμεθα*	*ἐπεπείσμεθα*
	2.	*ἐγέγραφθε*	*ἐπέπλεχθε*	*ἐπέπεισθε*
	3.	*γεγραμμένοι ἦσαν*	*πεπλεγμένοι ἦσαν*	*πεπεισμένοι ἦσαν*

The following are the inflexions of the same tenses of *ἀγγέλλω* (stem *ἀγγελ*), *I announce*, *τελῶ*, *τελέω* (stem *τελε*), *I finish*, and *φαίνω* (stem *φἄν*), *I show*:—

PERFECT INDICATIVE

Sing.	1.	*ἤγγελμαι*	*τετέλεσμαι*	*πέφασμαι*
	2.	*ἤγγελσαι*	*τετέλεσαι*	*πέφανσαι*
	3.	*ἤγγελται*	*τετέλεσται*	*πέφανται*
Dual	2.	*ἤγγελθον*	*τετέλεσθον*	*πέφανθον*
	3.	*ἤγγελθον*	*τετέλεσθον*	*πέφανθον*
Plur.	1.	*ἠγγέλμεθα*	*τετέλεσμεθα*	*πεφάσμεθα*
	2.	*ἤγγελθε*	*τετέλεσθε*	*πέφανθε*
	3.	*ἠγγελμένοι εἰσί(ν)*	*τετελεσμένοι εἰσί(ν)*	*πεφασμένοι εἰσί(ν)*

PLUPERFECT INDICATIVE

Sing.	1.	*ἠγγέλμην*	*ἐτετέλεσμην*	*ἐπεφάσμην*
	2.	*ἤγγελσο*	*ἐτετέλεσο*	*ἐπέφανσο*
	3.	*ἤγγελτο*	*ἐτετέλεστο*	*ἐπέφαντο*
Dual	2.	*ἤγγελθον*	*ἐτετέλεσθον*	*ἐπέφανθον*
	3.	*ἠγγέλθην*	*ἐτετελέσθην*	*ἐπεφάνθην*
Plur.	1.	*ἠγγέλμεθα*	*ἐτετελέσμεθα*	*ἐπεφάσμεθα*
	2.	*ἤγγελθε*	*ἐτετέλεσθε*	*ἐπέφανθε*
	3.	*ἠγγελμένοι ἦσαν*	*τετελεσμένοι ἦσαν*	*πεφασμένοι ἦσαν*

These changes were dictated by the Greek instinct for euphony, consonants that are difficult or impossible to pronounce together being assimilated to each other. Thus *βμ* changes to *μμ*, *βσ* to *ψ*, *βτ* to *πτ*, *κμ* to *γμ*, *κσθ* to *χθ*, *θμ* to *σμ*, and so on. Vowels also sometimes undergo change; thus *στέλλω*, *I send*, has perfect and pluperfect passive *ἔσταλμαι* and *ἐστάλμην*; *σπείρω*, *I sow*, has *ἔσπαρμαι* and *ἐσπάρμην*, and *τρέπω*, *I turn*, has *τέτραμμαι* and *ἐτετράμμην*. The inflexions of perfect middle stems ending in a labial are exemplified in *γέγραμμαι* and *ἐγεγράμμην*, those ending in a palatal in *πέπλεγμαι* and *ἐπεπλέγμην*, those in a lingual mute in *πέπεισμαι* and *ἐπεπείσμην*, those ending in *λ* or *ρ* in *ἤγγελμαι* and *ἠγγέλμην*: and those in *ν* in *πέφασμαι* and *ἐπεφάσμην*, Those tenses of *τελῶ* (viz. *τετέλεσμαι* and *ἐτετελέσμην*) are quoted to show how *σ* is added to the stem before *μ* and *τ*.

VOCABULARY

ἄπειρος, -ον, unskilful; *ἀπείρως ἔχειν, to be ignorant of.*
ἀποτρέπω, I turn away, turn from.
βλέπω, I see.
γράμμα -ατος, τό, letter, something written.
δεινός, -ή, -όν, fearful; *τὸ δεινόν, danger.*
ἐργάζομαι, I work.
ἔχω, I have, possess.
ἀπολύω, I free from, deliver.
ἄροτρον, τό, plough.
γενναίως, nobly.
γιγνώσκω, I know.
δικαστής, -οῦ, ὁ, judge.
ἔκγονος, ὁ, ἡ, offspring, descendant.
ἱκετεύω, I entreat, beseech.
καί, and, even, also.
καταλύω, I destroy.
κίνδυνος, ὁ, danger, risk.
θύω, I sacrifice.
κεύθω, I conceal.
μάντις, -εως, ὁ, soothsayer, seer.
μουσική, -ῆς, ἡ, art, music.
ὅταν, when, whensoever (with subj.).
ὅτε, when (with indic.).
πένομαι, I toil, am poor.
πλησιάζω, I approach.
πράσσω, I do work, fare.
κινδυνεύω, I incur danger, risk.
νόμος, ὁ, law.
οὕτως, οὕτω, thus.
παιδεία, ἡ, education, training.
Πλαταιαί, -ῶν, αἱ, Platæa.
προσπίπτω, -πεσοῦμαι, I fall upon, befall.
πρόνοια, ἡ, foresight, thought.
φυτεύω, I plant.

Exercise 10

(*a*) Translate into English:—

1. *Ὁ μάντις τῷ θεῷ ἔθυσεν.* 2. *Ὁ μάντις τῷ θεῷ βοῦς ἑκατὸν τέθυκεν.* 3. *Ἀλέξανδρος Βαβυλῶνα κατελελύκει.* 4. *Ἐκεῖνος πένεται καὶ ὀλίγους φίλους ἔχει.* 5. *Αἱ γυναῖκες καλαὶ εἰσιν ὅταν νοῦν σώφρονα ἔχωσιν.* 6. *Ὁ νεανίας μουσικῆς ἀπείρως ἔχει.*

(*b*) Translate into Greek:—

1. The citizen keeps the laws. 2. This road leads to the city. 3. My father takes thought for my education. 4. These girls are ignorant of music. 5. Two men are fleeing. 6. Alexander destroyed Babylon.

Key to Exercise 9

(*a*) 1. We shall be loosed *or* set free. 2. We shall be set free *or* have been liberated. 3. Be thou loosed. 4. Show thou. 5. We showed. 6. We appeared. 7. We shall appear *or* be shown. 8. He will be free *or* have been set free. 9. We were loosed. 10. About to be set free. 11. We might be loosed. 12. I may loose myself. 13. I was left behind. 14. You might loose yourselves. 15. I might be left behind. 16. I may have remained behind. 17. You loosed yourself. 18. You were loosing yourselves. 19. I had been loosed. 20. I shall be loosed.

(*b*) 1. *Λυοίμην*. 2. *Λύωμαι*. 3. *Ἐλυόμην*. 4 *Ἐλυσάμην*. 5. *Λύονται*. 6. *Ἐλύοντο*.

E. A. B.

ITALIAN.—XII

The Verb. — The endings of the Conditional Mood for all three conjugations, regular and irregular verbs, are **-éi, -esti, -ebbe, -emmo, -este, -ébbero**, added to the stem of the future, given on page 344.

Conditional Mood

Avere	Éssere
Sing.	
avréi, *I should have*	saréi, *I should be*
avresti, *thou wouldst have*	saresti, *thou wouldst be*
avrebbe, *he would have*	sarebbe, *he would be*
Plur.	
avremmo, *we should have*	saremmo, *we should be*
avreste, *you would have*	sareste, *you would be*
avrébbero, *they would have*	sarébbero, *they would be*

In the regular conjugations the endings are as follows :—

Comprare	Véndere	Partire
Sing.		
comprer-éi	vender-éi	partir-éi
comprer-esti	vender-esti	partir-esti
comprer-ebbe	vender-ebbe	partir-ebbe
Plur.		
comprer-emmo	vender-emmo	partir-emmo
comprer-este	vender-este	partir-este
comprer-ébbero	vender-ébbero	partir-ébbero

It will have been observed that the endings of the Future in Italian are taken from the Present Tense of **avere**, whilst the terminations of the Conditional are those of the Past Definite of **avere**, omitting the **bb** of the 1st person singular.

To form the Imperfect Subjunctive, substitute *for all verbs* the following endings for the *sti* of the 2nd person singular of the Past Definite : **-ssi, -ssi, -sse, -́ssimo, -ste, -́ssero.**

The Imperfect Subjunctive

Avere	Éssere
Sing.	
avessi, *I had*	fossi, *I were*
avessi, *thou hadst*	fossi, *thou wert*
avesse, *he had*	fosse, *he were*
Plur.	
avéssimo, *we had*	fóssimo, *we were*
aveste, *you had*	foste, *you were*
avéssero, *they had*	fóssero, *they were*

Comprare	Véndere	Partire
Sing.		
compra-ssi	vende-ssi	parti-ssi
compra-ssi	vende-ssi	parti-ssi
compra-sse	vende-sse	parti-sse
Plur.		
comprá-ssimo	vendé-ssimo	partí-ssimo
compra-ste	vende-ste	parti-ste
comprá-ssero	vendé-ssero	partí-ssero

The Imperfect Subjunctive is generally used for past time, after **se**, *if*, but in the present tense **se** requires the Indicative.

The Subjunctive Mood, in most cases preceded by **che**, is used (1) after expressions of mental emotion, especially verbs expressing consent, command, doubt, desire, surprise, want, duty, necessity, regret, fear, etc. (2) After impersonal verbs. (3) After negative or interrogative verbs. (4) After superlatives. (5) After certain conjunctions, such as :—

ancorchè, benchè, malgrado che, quantunque, sebbene, *though, although*
purchè, *provided that*
sia che, *whether*
prima che, *before*
quand'anche, *even if*
per tema che, *for fear that*
se, *if* (not whether)
a meno che (non), *unless*
in caso che, *in case*
affinchè, *in order that, so that*
non ostante che, *notwithstanding that*
finchè (non), *until*
senza che, *without*
dato che, posto che, supposto che, *supposing that.*

The action or condition may be looked upon as *doubtful* or dependent upon something else happening when the Subjunctive Mood is used. The following examples will best show the use of the Conditional and Subjunctive Moods :—

Examples

Vi manderéi una rimessa, se potessi,	*I should send you a remittance if I could* (were able).
Se l'aveste saputo, me l'avreste detto,	*If you had known* (it), *you would have told me* (it).
Lúi non potrebbe farlo, se noi non gli déssimo (irreg. Impf. Subj. of **dare**) la nossa assistenza,	*He could not do it, if we did not give him our help* (assistance).
Se ci domandássero un prezzo così alto, ci troveremmo nell' impossibilità di accettarlo,	*If they asked us* (lit. demanded to us) *such a high price, we should find ourselves unable* (lit. in the impossibility) *to accept it.*
Rincrescebbe loro che io non volessi accettare l'órdine,	*They would regret* (lit. it would cause sorrow or regret to them) *that I should not wish* (should not be willing) *to accept the order.*
Se ci vedéssimo un píccolo márgine di profitto, accetteremmo la loro offerta,	*If we saw a little margin of profit in it, we should accept their offer.*

Gli rincrescerebbe molto che loro non gli facéssero (from **fare**, old form, **fácere**) una vísita,	*It would cause him much regret that they should* (did) *not pay him a visit.*
Se voi l'aiutaste, quanto vi darebbe ?	*If you helped him, how much would he give you ?*

The following is a peculiar use of the Conditional Past :—

Comprammo questa merce a patto che i fabbricanti ce l'avrébbero cangiata se non ci soddisfacesse,	*We bought these goods on the condition that the manufacturers would change them if they did not satisfy us.*

The Conditional Past is frequently used in this way instead of the simple form.

Qualche, meaning *some, a few*, is always followed by the singular.

VOCABULARY

negare, *to deny.*
colpévole, *blameworthy, guilty.*
inténdere, *to understand.*
proibire, *to forbid.*
riuscire, *to succeed.*
sembrare, *to appear, seem.*
rimproverare, *to reproach, reprove.*
il telegramma, *telegram.*
per quanto (with subj.), *however.*
il cambio, *exchange.*
cadere, *to fall.*
costare, *to cost.*
la commissione, *commission.*
la percentuale, *percentage.*
Torino, *Turin.*

Exercise 23

Translate into English :—

1. Sarebbe impossíbile che avéssimo detto ciò. 2. Cercherái (from cercare) un commesso che sapesse corrispondere in francese ed italiano. 3. Io non negava (negavo) che lúi fosse colpévole. 4. Credevate voi che noi l'avéssimo scritto ? 5. Vorremmo ch'egli venisse súbito da noi, per paúra che non c'intendéssimo bene. 6. Erano lietíssimi che il loro viaggiatore fosse in istato di préndere tanti òrdini. 7. Diceste loro che preparássero l'invío súbito súbito. (This repetition of a word in Italian is like prefixing *very*—súbito súbito, *very quickly, without the slightest delay.*) 8. Temerái che partisse prima di me. 9. Consentírono che voi eseguiste la prima parte. 10. Per quanto ricchi che fòssero, non dovrébbero rifiutarvi questo píccolo favore. 11. Era la casa più grande che noi avéssimo mai veduta (vista). 12. Qualunque fòssero i loro motivi, non avrébbero dovuto préndere gli òrdini senza che noi ne avéssimo dato loro il permesso. 13. Ve lo direbbe, se potesse, quand'anche ne fosse punito più tardi. 14. A meno che non ce lo proibíssero, lo faremmo, finchè non riuscissimo. 15. Sembrerebbe loro che noi non voléssimo farlo, per tema che ci punissero.

Exercise 24

Translate into Italian :—

1. Would you send me a remittance if you could, or would you prefer that I waited until the exchange fell (negative after **finchè**)? 2. Unless they executed (negative after **a meno che**) the order before the end of the month, I should give it to another firm, although this might cost me more. 3. Would they be sorry (impersonal : **rincréscere**, conditional : **rincrescerebbe**—with dative) if he did not return ? 4. If we had known it, we should have written it to you. 5. Although I saw only a very small margin of profit in it, I should accept their offer with pleasure. 6. If I helped you, how much would you give me ? 7. They could not do the correspondence unless we helped (negative) them. 8. Supposing that I were willing to do this, how much would they give me ? 9. I should do the business, if only they gave me a reasonable percentage of commission. 10. I am sure (that) he would do it for me, even if he had to (impf. subj. of **dovere**) suffer for it (**ne**) later. 11. If it were necessary that I should do it at once, I would do so (it), even though they punished me later for it (**ne**). 12. In order that you might know it at once, I should send you a telegram from Turin. 13. Unless they forbade (negative) me (it to me), I should wait until I received your letter.

Key to Exercise 16

1. Érano qui ieri quando scrivevamo ai clienti che non avévano ancora pagato (pagati) i loro conti ? 2. Dátavene una parte, pensavamo che era meglio dárvene il resto. 3. Ciò che era bastato per loro, non è stato abbastanza per noi quattro. 4. Riandando i miéi libri, trovo che non avete pagato ancora le fatture del mese scorso. 5. Temévano di pérdere la nostra clientela e perciò eseguívano sempre i nostri órdini a prezzi favorévoli. 6. Non temevate di trovarmi in casa ? 7. Quando vi é stata presentata la tratta ? 8. Ci è stata presentata iéri e le abbiamo dato buona accogliénza alla presentazione. 9. Sapete dove è la pólizza di assicurazione per questo invío ? 10. Immagazzinávano i nostri colli per due o tre mesi prima di spedirli al consegnatari. 11. Ci dice che il progetto è qualcosa di straordinario.

Key to Exercise 17

1. Having had much time this afternoon, we have written various letters to the customers (clients) on the same subject. 2. He had asked me why you had spoken so long with the forwarder in the warehouse (shop) of our friend. 3. Because we have to send a quantity of packages to Leghorn and it was necessary for us to arrange a lower freight. 4. The pupils (scholars) had finished their lessons. 5. His (her) letters had been very well written by the travellers' friend. 6. We have seen with pleasure from yours of the 8th ultimo that soon we shall have the opportunity of speaking with you. 7. We are pleased (satisfied) with these black cloths, and if you will have the goodness to come to our house to-morrow, we shall have much pleasure in (we shall be very glad to) giving you a detailed explanation. 8. We can assure you that it is a question of a misunderstanding. 9. The aims of our house have always been those of serving our customers properly. 10. You are the same as before, and I believe that you always will be so. 11. I shall be ready in a few minutes, if you will be so kind as to wait. 12. These buyers were more reasonable than those who had purchased our stocks of grey (unbleached) cloths. 13. The grey (grey-coloured) cotton was of a much better quality than that of the grey (unbleached) textiles (woven goods). 14. With the other letter, I have received a remittance of two hundred and fifty pounds sterling on the same bank. 15. I thank you again for the favour which you have done my traveller. 16. Your esteemed letter of the 15th ultimo has arrived this morning and we shall take care to reply to it as soon as possible. 17. My orders are small now, but later they will be greater (of larger size). 18. The Englishmen who have sold all their white cloths came (have come) to our house yesterday evening. 19. The Englishman with his parents (relatives) came last month and left a fairly considerable order. 20. The Italians have had all their sendings insured and have paid the premium before the departure of the steamer.

A. C.

SPANISH.—XII

Imperative Mood.—The only irregularities occur in the 2nd Person Singular of the Affirmative form, which should be like the 2nd Person Singular of the Present Indicative, minus the final "s" of latter; or, in other words, it is exactly like the 3rd Person Singular of the Present Indicative, with certain exceptions, as follows :—

Infinitive	3*rd Pers. Sing. Pres. Ind.*	2*nd Pers. Sing. Affirm. Imp.*
decir, *to say*	él dice	di tú
haber, *to have*	él ha	hé tú*
hacer, *to do*	él hace	haz tú
ir, *to go*	él va	vé tú
poner, *to put*	él pone	pon tú
salir, *to go out*	él sale	sal tú
satisfacer, *to satisfy*	él satisface	satisfaz tú, *or* satisface tú
ser, *to be*	él es	sé tú
tener, *to have*	él tiene	ten tú
valer, *to be worth*	él vale	vale *or* val tú
venir, *to come*	él viene	ven tú

In the 2nd Person Plural Affirmative Imperative the final "d" is omitted before "os," as **amaos** (for amad-os), *love* (*ye*) *one another*. The omission of this "d" is made to avoid confusion with the Past Participle, the only exception being **irse,** *to go away*, which makes **¡idos !** *go* (*ye*) *away!* (Reflexive verb, literally, go ye yourselves away, something similar to the English colloquialism, "Take yourselves off !")

It should again be pointed out that these second persons, singular and plural, are always replaced in business phraseology by the 3rd Person with **V.** or **Vs.**

Present Indicative.—The following are the main irregularities :—

absolver—absuelvo, absuelves, absuelve, absolvemos, absolvéis, absuelven.
asir—asgo (rest of tense is regular).
caber—quepo (rest of tense is regular).
caer—caigo (rest of tense is regular).
conducir—conduzco (rest of tense is regular).
dar—doy (rest of tense is regular).
decir—digo, dices, dice, decimos, decís, dicen.
erguir—irgo, irgues, irgue, erguimos, erguís, irguen, *also* yergo, yergues, yergue, erguimos, erguís, yerguen.
errar, *to err*—yerro, yerras, yerra, erramos, erráis yerran.
estar—estoy (rest of tense is regular).
haber—he, has, ha, hemos, habéis, han.
hacer—hago (rest of tense is regular).
huir, *to flee*—huyo, huyes, huye, huimos, huís, huyen.
ir—voy, vas, va, vamos, vais, van.
jugar, *to play*—juego, juegas, juega, jugamos, jugáis, juegan.

*"**He**" exists as a form only, seeing that the Imperative Mood of **haber** is not used in modern Spanish except in **Héte aquí**! *Here thou art!* etc.

morir—muero, mueres, muere, morimos, morís mueren.
oír—oigo (rest of tense regular)—oyes, oye, oímos oís, oyen.
pedir—pido, pides, pide, pedimos, pedís, piden.
poder—puedo, puedes, puede, podemos, podéis, pueden.
poner—pongo (rest of tense is regular).
querer—quiero, quieres, quiere, queremos, queréis quieren.
saber—sé (rest of tense is regular).
salir—salgo (rest of tense is regular).
ser—soy, eres, es, somos, sois, son.
tener—tengo, tienes, tiene, tenemos, tenéis, tienen.
traer—traigo (rest of tense is regular).
valer—valgo (rest of tense is regular).
venir—vengo, vienes, viene, venimos, venís, vienen.
ver—veo, ves (rest of tense is regular).

VOCABULARY

dar los pasos necesarios, *to take the necessary steps.*
tener derecho á, *to have a right to, to be entitled to.*
el peligro, *the danger.*
la felicidad, *happiness, good fortune.*
quejarse de, *to complain of.*
causar, *to cause.*
serio, *serious.*
repetir (like pedir), *to repeat.*
mantener, *to maintain, keep.*
al descubierto, *open, unpaid, uncovered* (of accounts).
cuanto antes, *as soon as possible.*
crecido, *considerable, large.*
favorecer (like conocer), *to favour.*
en liquidación, *in settlement.*
lo debido, *what is owing.*
tanto como, *as much as.*
admitir, *to admit, allow.*
tomar la delantera, *to take the lead.*
Don, *Mr.*, a title of respect used before the Christian name of a man.
Don José, *Mr. Joseph.*
Don Juan, *Mr. John.*
viejo, *old.*
confiar, *to trust.*
por lo tanto, *therefore.*
remesar, remitir, } *to remit.*
de seguida, en seguida, } *at once.*
la parte, *the part.*
el saldo, *the balance.*
adjunto, *enclosed, herewith.*
el interés, *the interest.*
respectivo, *respective.*
anteriormente, *previously, formerly.*
salvar, *to save, rescue.*
suscrito, *subscribed.*
la compañía, *the company.*
la cantidad, *the amount, sum.*
increíble, *incredible.*
el millón, *the million.*
la libra esterlina, *the pound sterling.*
el amor, *the love.*
por el amor de Dios, *for the love of God* (say, for goodness' sake).
arriesgado, *risky.*
la ignorancia, *the ignorance.*
ninguno -a, ningunos, -as, } *no.*
el arreglo, *the arrangement.*
resentido, *touchy.*
quisquilloso, *particular, fastidious.*
difícil, *difficult.*
acomodarse á, *to fall in with.*
la manera, *the way.*
desprenderse de, *to part with, give out.*
halagar, *to humour, cajole, coax.*
maneras de proceder, *way of dealing.*
el proceder, *the proceeding, behaviour.*
la participación, *the participation.*
va á hacer, *he is going to make.*
tener la felicidad de, *to be lucky enough.*
el juicio, *the judgment.*
tratar, *to deal.*
hacer otro tanto para alguien, *to do the same for anybody.*
la fiebre, *the fever.*
aquellos parajes, *those parts, that district.*
según, *according to.*
propio, (one's) *own.*

referente á, *referring to.*
poner en juego, *to put into play, to put forth.*
la fuerza, *the strength, endeavour.*
pronto, *soon, early.*
el desempeño, *the execution* (of an order).
la tentación, *the temptation.*
el especulador, *the speculator.*
la idea, *the idea.*
jugar, *to gamble, play* (a game).
pues, *for, because.*
desviarse de, *to deviate from.*
prestar, *to lend.*
en adelante, } *in*
en lo venidero, } *future.*
pedir prestado, *to borrow.*
tomar dinero prestado, *to borrow money.*

Exercise 21

Translate into English :—

1. Sé que ha dado V. los pasos á que tenía derecho. 2. Les digo á Vs. esto para que sepan como evitar ese peligro. 3. Salgo todos los días buscando pedidos pero no siempre tengo la felicidad de conseguirlos. 4. Si hago todo lo que puedo, nadie podrá quejarse de mí. 5. Si muere el jefe de la casa, eso nos causará perjuicios serios. 6. Oigo bien lo que me dicen ellos y no es necesario que repitan nada. 7. Pueden mantener la cuenta al descubierto por algún tiempo, pues no faltaré de pagarla cuanto antes. 8. Quiero que me diga V. una cosa, ¿cómo es que V. ha mantenido al descubierto por tanto tiempo la cuenta de un cliente que ya nos debía una suma tan crecida? 9. Aquí les traigo á Vs. el estado de su cuenta y me permito suplicarles me favorezcan cuanto antes con remesa en liquidación de lo debido. 10. Valgo tanto como él y no admito que me tome la delantera. 11. Vengo á decir á V., Don José, que nuestra cuenta ya se ha hecho viejo y confío por lo tanto que tendrá V. la bondad de remesarnos de seguida parte ó todo del saldo. 12. Adjunto les remeso á Vs. el saldo de su cuenta con sus intereses respectivos, esperando que quedemos tan buenos amigos como anteriormente.

Exercise 22

Translate into Spanish :—

1. No arrangements can be made with such a touchy man (Begin, No se pueden hacer, etc.). 2. This customer is a very particular man and it is difficult to please him. 3. Fall in with his ways and you will soon see how he will give out (part with) his orders. 4. I advise you to humour him and to fall in with his way of dealing. 5. I absolve you (pl.) from all participation in this matter. 6. I see that you have taken the steps to which you were entitled. 7. He tells me that he is going to make a journey to Spain. 8. When I go out seeking orders, I am not always lucky enough to obtain them. 9. He never errs in his judgment of the persons with whom he is dealing. 10. If I do all I can for you, I am sure you will do the same (= otro tanto) for me. 11. There is always fever in those parts (district), and people are dying there every day.

Key to Exercise 13

1. They want us to write the letters. 2. We want you to tell the truth. 3. We do not think that it is the same design. 4. Is it possible that there are persons (people) who do that? 5. Do you think that it is possible to arrive before night? 6. I regret exceedingly that you (should) take (have) so little care in this matter. 7. You can depend upon our being ready in time for the departure of the steamer. 8. It is necessary that you should give us the best qualities that there are in the market. 9. We are astonished that the little table does not fit (find room) in this corner. 10. This manufacturer is the best man living. 11. These are the best designs that the manufacturer has. 12. It would be indispensable that you should pack the goods ordered well, for fear that they should get wet during the voyage. 13. Let us wait until a more favourable opportunity presents itself. 14. There will be many more steamers after the conclusion of peace. 15. Before you are in this city, there is no possibility of our doing what you wish. 16. Whether he knows or not, it matters little to me. 17. Come nearer to me so that I may hear you better. 18. I am telling you this in order that you may not make the same mistake (fall into the same error) as I. 19. Let it be worth what it might, I do not want it, nor do I wish you to see it either. 20. I have told everything to my friend in order that he may, if he wished, become reconciled with his father before the latter dies.

Key to Exercise 14

1. Tráigame V. todo lo que tenga y escogeré lo que haya de conveniente. 2. Deseo que V. vea los nuevos dibujos y que me diga lo que piense de ellos. 3. Sírvanse Vs. darnos todos los detalles afín que podamos seguir á la letra sus instrucciones. 4. No creo que sea el mismo diseño (dibujo), pero es posible que el cliente lo acepte. 5. ¿Cree V. que sea posible que haya personas tan estúpidas? 6. Sírvase V. darme las mejores calidades que pueda hallar. 7. Él puede contar con que yo salga antes que llegue. 8. No es posible que oiga cuando hay tan ruido en el cuarto. 9. Dígame V. cuáles son los mejores dibujos que tiene el fabricante. 10. Sería indispensable que yo embalase los géneros en cañamazo doble de miedo que se mojasen antes que el envío llegase a su destino. 11. Es necesario (menester) que ellos explicasen todo a su socio antes que muera, afín que pueda cambiar las disposiciones de su testamento. 12. Lleve V. estos farditos, para que las nuevas entregas puedan caber en este rincón.

Key to Exercise 15

1. Allow me to tell you something and do not interrupt me. 2. The best markets we have are the South American ones. 3. I am seeking the best market that there is in the world. 4. Unless you give me your word, I shall not accept. 5. We are ruined, unless something unexpected happens. 6. For fear that the post may not arrive in time, we shall send a telegram. 7. When (after) we have finished our work, we shall go away. 8. Before you speak, consider a little the present circumstances. 9. However he may have spoken, I shall not give up my intention. 10. Provided that the steamer arrives in time, the draft will not be dishonoured. 11. Supposing that I do what you propose to me, what will be the result? 12. Provided that the drafts are not dishonoured on their presentation, we shall have nothing to fear. 13. Execute the orders in such a way that (so that) the clients will be satisfied. 14. Whether we pay it or not, it does not matter to you. 15. He does not want to do it, notwithstanding that I have requested (begged) him most earnestly. 16. When you pay a visit to our friends, you should always take enough money with you for your expenses. 17. When we have time, we shall not fail to do what you ask us now. 18. Until you deliver to me the signed contract, I shall do nothing. 19. I have written the letter in this way so that you may be informed (may know) my true feelings. 20. Except we receive a reply and unless you promise to keep your word, we shall not consent.

A. C.

Continued from page 428.

GEOGRAPHY:

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EUROPE.—II

WITH the exception of minerals, which, of course, are subject to other influences than those which have their existence above ground, the products of Europe are fairly evenly distributed. It goes without saying that the growths of warm countries, such as wine and oranges, are to be met with in the south rather than in the north, and that the reverse condition of affairs holds good—as regards quality and breed, at all events—with cattle, sheep and many similar animals.

On the other hand—with the exception, of course, of the furthest north and the furthest south—it is not easy to draw any precise frontiers for these various products. Thus two or three hundred years ago wine was freely produced in England, and, as it is, the grape flourishes in many districts of Europe practically as far north as latitude 50° N.

Mineral Wealth

To deal first of all with the minerals, the principal coalfields are found in England and Wales, Germany, France and Belgium, and Russia. Petroleum is met with in enormous quantities on the western shore of the Caspian Sea in Russia, and is also found to an important extent in Roumania. Iron obtains in England, Northern Spain, North-Eastern France, Germany, Sweden, Finland and Russia, while the south-west of England, the west of Spain, Italy and Hungary produce copper. Tin is found in Cornwall and gold and platinum in the Ural Mountains. Beyond this there is little of importance to remark on, although this list by no means includes all the minerals which are scattered about the continent in the areas of minor mineral importance.

The sole other crude product of primary importance is timber, and this is met with in the forests of Sweden, Norway, and of Central and Northern Russia. The crude products of Europe, as a matter of fact, do not occupy a large proportion of her industries. It is only natural that so densely populated a continent should be concerned rather with the importation of the raw materials from other parts of the world, and that it should take their manufacture in hand.

As regards her agricultural products, too, it may be said that Europe is famed for quality rather than mere quantity. The continent, in fact, specialises (if the term be allowable in this sense) in both her agricultural and pastoral products. Thus the wines of France, Spain, Portugal, and Germany are universally famous, and are sought after all the world over. The British livestock holds a similar position of supremacy, although, strictly speaking, we are not concerned with this latter here, the British Isles falling within another chapter.

Vineyards of Portugal

We may now take a rapid survey of the industries of the various countries in turn, proceeding from west to east across the continent.

Following this itinerary, we come first of all to Portugal. It is true that the historical past of this country exceeds its present status. Nevertheless the industries of Portugal are by no means in a decadent condition at the present time. One of the chief of these is the manufacture of port wine, which is carried on in the Douro district. Other wines, of inferior quality to those of the Douro, are produced practically all over the republic, some enormous vineyards existing in the southern province of the Alemtejo. This latter province is the chief centre of the important Portuguese cork industry, a large part of its lands being covered with the forests of cork-oak.

Agriculture in general, and fruit-growing in particular, is carried on very extensively throughout Portugal, and a considerable amount of afforestation has been effected in some of the sandy regions, a process that has been undertaken with marked success. The eucalyptus has now been introduced freely into the southern districts.

As regards manufactures Portugal, being essentially a pastoral and agricultural country, is not much concerned. The Portuguese, however, are skilled jewellers, and the savings of the peasant women are in many districts, especially in the north, invested in massive golden brooches, which at the same time represent an ornament and their financial capital.

In Spain, as in Portugal, one of the chief products is wine, the principal wine-producing districts being Jerez, from the vineyards of which comes the famous sherry and Malaga, a district on the south coast from which is derived the Malaga wine which at one time enjoyed a far wider popularity than it does now.

The Spanish cork industry is an important one, the cork forests of the south-west adjoining the area of similar growths in Portugal. In the south fruit is extensively cultivated, Seville oranges being especially famous, other fruits which thrive particularly being lemons, grapes and mulberries. The climate of the south allows a little sugar, cotton and rice to be grown. The vegetable which Spain produces in the greatest abundance is the onion, the quality of the Spanish onions being famous all the world over.

A certain amount of mule breeding is carried on, and the wool of the Spanish sheep is notable for its quality. The breeding of pigs and goats is extensively conducted. The cattle-raising industry, on the other hand, is of secondary importance.

Industrial Spain

The manufactures of Spain are of greater importance compared with the agricultural and pastoral produce than is the case in Portugal. Barcelona is the chief manufacturing centre. Its principal manufactures are " soft " goods such as silks, cottons and woollens, and a certain quantity of firearms is made here as well. The manufactures of Valencia are somewhat similar, although on a smaller scale.

Malaga has already been mentioned as a wine-producing centre, and in addition to this it is famed for the quality of its raisins, which are largely exported. Cadiz, too, is a wine and fruit centre, and, in addition, manufactures important quantities of olive oil.

Passing across the Pyrenees to the eastward into France, we arrive at one of the richest countries in Europe. The industries of the French Republic, as a matter of fact, cover a very wide scope, and she derives great wealth from her manufactures as well as from her agricultural industries. France represents one of the only two European countries that possesses a coastline on both the Atlantic Ocean and the Mediterranean Sea. Thus, whereas in the north the republic produces wheat, barley, and all the cereals that thrive especially in those latitudes, in the south she is able to grow the olive, tobacco, oranges and maize, besides producing early fruits and vegetables of all kinds which are sent by rail to Paris, and which come in large quantities to London. In the south, too, the cork-oak is met with, although it does not flourish here in anything like the profusion that is characteristic of the tree in Spain and Portugal.

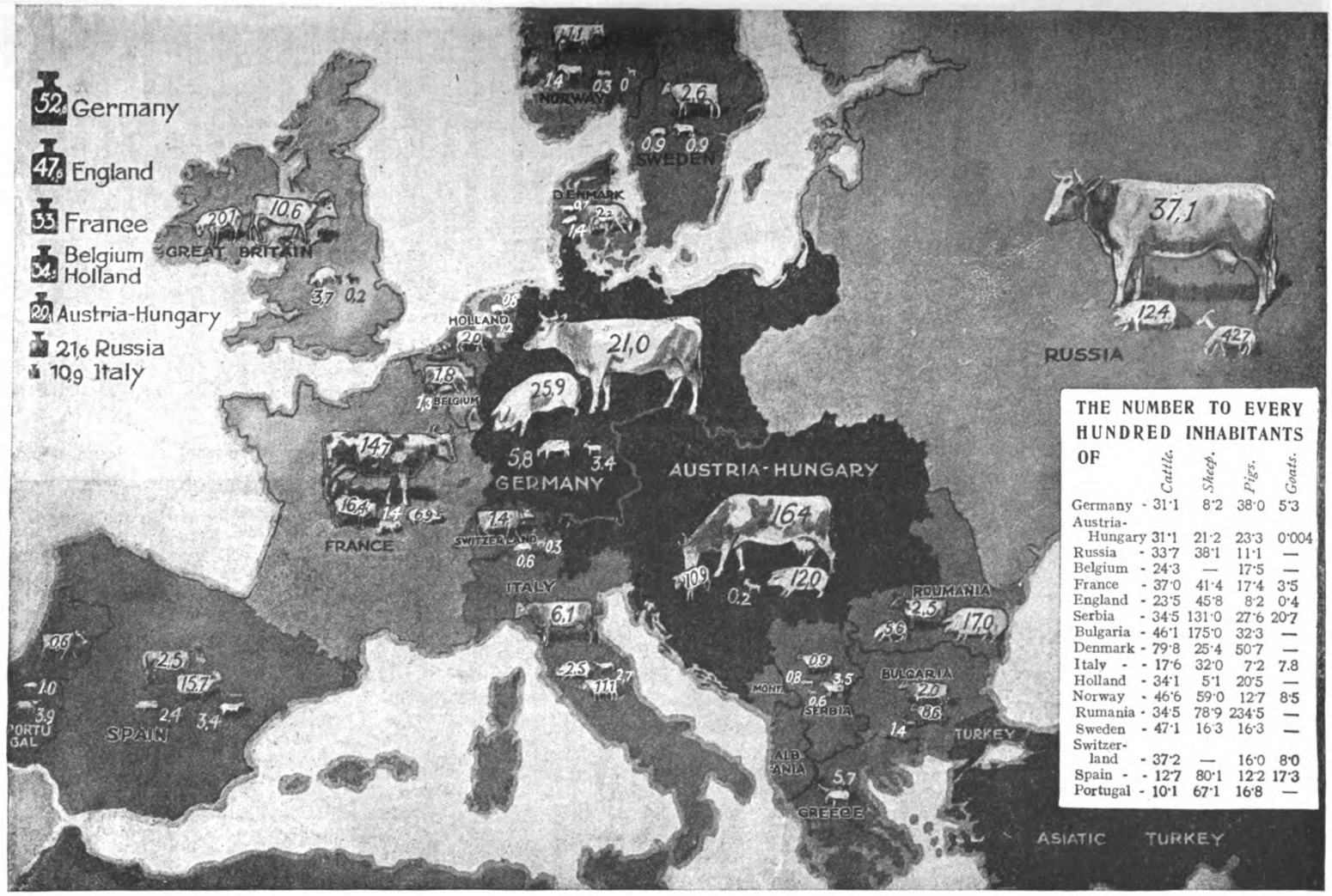
French Wines and Silk

Wine-making is one of the most notable of the French industries, and in this respect France is perhaps more famous than any other country. The most prominent wines are claret, champagne and burgundy. Claret is produced in the country which lies at the back of Bordeaux. The great champagne centres are Epernay and Rheims, the latter of which towns has suffered so severely in the course of the war. Sillery is the centre of a district which yields a wine very similar to champagne, though of a lighter quality. The burgundy producing district is known as the Côte d'Or, and two of the chief centres here are Beaune and Maçon. Brandy is distilled in the Charente district, Cognac being the principal centre.

So far as livestock breeding is concerned, France produces all the ordinary species of domestic animal, although the strain of these cannot compete with those bred in England. The Norman *Percheron* draught horse, however, is noted for its good qualities, and is exported rather largely to the agricultural countries of South America.

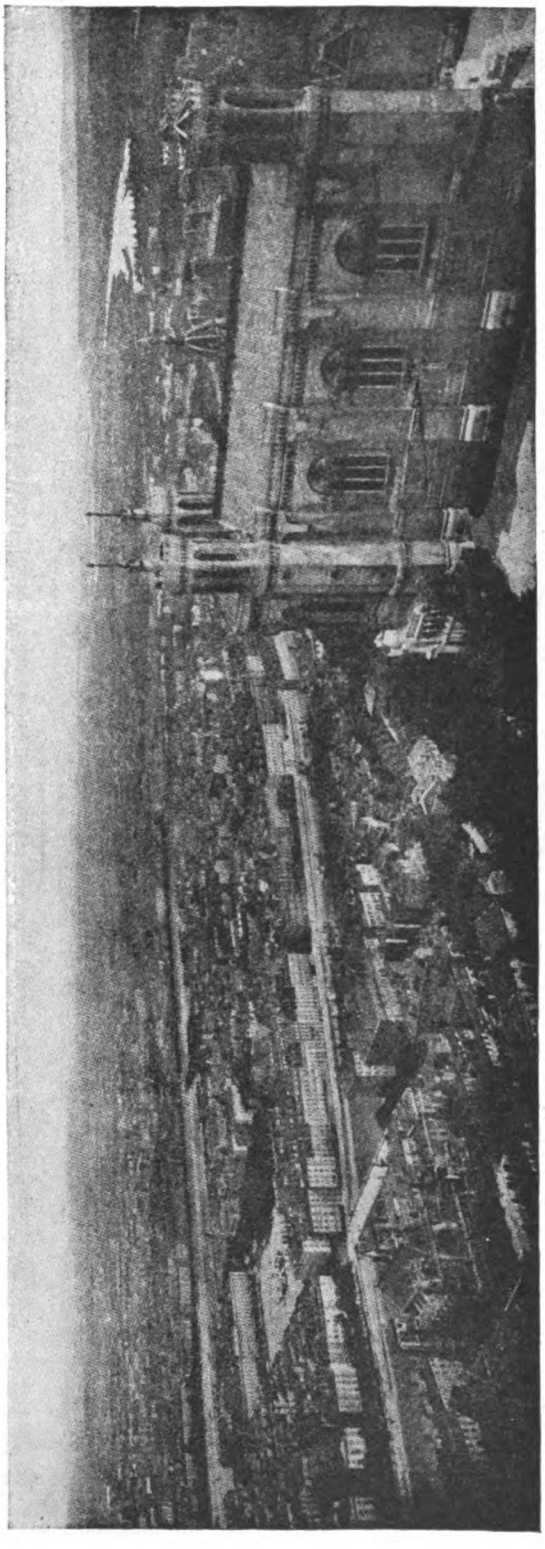
The manufacture of wine, which has already been referred to, is the most important French industry. Next in order comes the manufacture of silk, of which Lyons is the centre. Other notable French industries are those of linen, woollen and cotton goods. Porcelain is manufactured principally at Sèvres.

In passing from France to Germany it is necessary—as is the case, too, in referring to Europe as a whole—to deal with the general condition of affairs as it was previous to the outbreak of war, although, as a matter of fact, in no country are the changes likely to be so drastic as in the collection of states that go to make up Germany.



	Cattle.	Sheep.	Pigs.	Goats.
Germany	31·1	8·2	38·0	5·3
Austria-Hungary	31·1	21·2	23·3	0·004
Russia	33·7	38·1	11·1	—
Belgium	24·3	—	17·5	—
France	37·0	41·4	17·4	3·5
England	23·5	45·8	8·2	0·4
Serbia	34·5	131·0	27·6	20·7
Bulgaria	46·1	175·0	32·3	—
Denmark	79·8	25·4	50·7	—
Italy	17·6	32·0	7·2	7·8
Holland	34·1	5·1	20·5	—
Norway	46·6	59·0	12·7	8·5
Rumania	34·5	78·9	234·5	—
Sweden	47·1	16·3	16·3	—
Switzerland	37·2	—	16·0	8·0
Spain	12·7	80·1	12·2	17·3
Portugal	10·1	67·1	16·8	—

Map (based on pre-war estimates) showing the normal European Trade in Meat. The political divisions created by the Peace of Versailles (1919) will no doubt considerably influence these figures.



Lyons, showing the junction of the rivers Rhone and Saone. Lyons is the centre of the silk manufactories which, next to the making of wine, constitute France's most important industry.

The agricultural products of Germany are very important, but the actual range of these is not so wide as is that of the French products, as Germany possesses no latitudes which permit the growths such as those of Southern France. Wine is produced in Central and South Germany, the most favoured districts being the valleys of the Rhine, Moselle, and Main. Hops, too, constitute an important growth, and more hops are produced in Germany than in any other European country. The cultivation of sugar-beet is one of the most important industries of the north, and other staple products are rye, wheat, barley, oats and potatoes.

Germany's Forest Wealth

The forest wealth of Germany is considerable, the most extensive areas of timber being met with in the Black Forest in the south of the country. All the ordinary kinds of domestic livestock are raised, and in many districts breeding is carried on in an extensive fashion.

The manufactures of Germany have increased enormously in importance during the last quarter of a century, and had it not been for the lust for military domination to which the country had devoted itself, the industrial and commercial future would almost certainly have been brilliant. In the iron and steel industries the country ranked second to the United States alone, and in textile fabrics, woodwork, glass, beer and porcelain a very important place was occupied. Much shipbuilding, moreover, was undertaken, the principal centres of marine construction being Stettin, Bremen and Hamburg.

Switzerland is largely a pastoral country, though industrially it is, of course, known everywhere on account of its trade in inexpensive watches.

The flat country of Holland is a busy producer of both agricultural and manufactured objects. Cattle-breeding and dairying is an important industry, and much of the dairy produce is exported to England. The industry, however, for which Holland has been most famed for centuries is that of tulip growing. The Dutch tulip fields present a

glowing sight, and the bulbs are exported all over the world. Hyacinths are also grown and exported to a large extent. Another characteristic product is the Hollands gin.

The general manufactures of the country include metal work of all kinds, glass, Delft ware, carpets, and cotton and linen goods. The fishing industry of Holland, it may be added, is an important one, the Dutch fishermen sharing the fishing grounds with the British.

The small but densely populated country of Belgium grows the usual cereals of Europe, as well as large quantities of potatoes, tobacco and hops, while a number of cattle, sheep and horses are bred. The chief source of Belgian wealth, however, lies in her manufactures. The most important of these are textile fabrics and metal goods.

The chief centres of the former industry are Brussels, Mechlin, Antwerp, Bruges and Ghent. In addition to this, Belgium is famous for the quality of its lace, the headquarters of this craft being Brussels. The principal metal-working towns are Liège, Charleroi and Namur. The manufacture of glass is an important Belgian industry, and large quantities of this are exported to Great Britain.

Denmark is essentially an agricultural country, and the breeding of livestock and dairy farming are its chief industries. Danish butter has been very largely consumed in England for a long time now, and the chief remaining exports are eggs, pork and smaller quantities of livestock and cereals. This will give an idea of the general type of Danish products, but in addition to these there is also a certain amount of weaving carried on. The manufacture of porcelain, although not extensive, produces some of the finest modern specimens of the art, and the peculiar gloss and smoothness of the Copenhagen ware fetches very high prices for its best specimens.

The mountainous and rugged land of Norway derives much of her wealth from

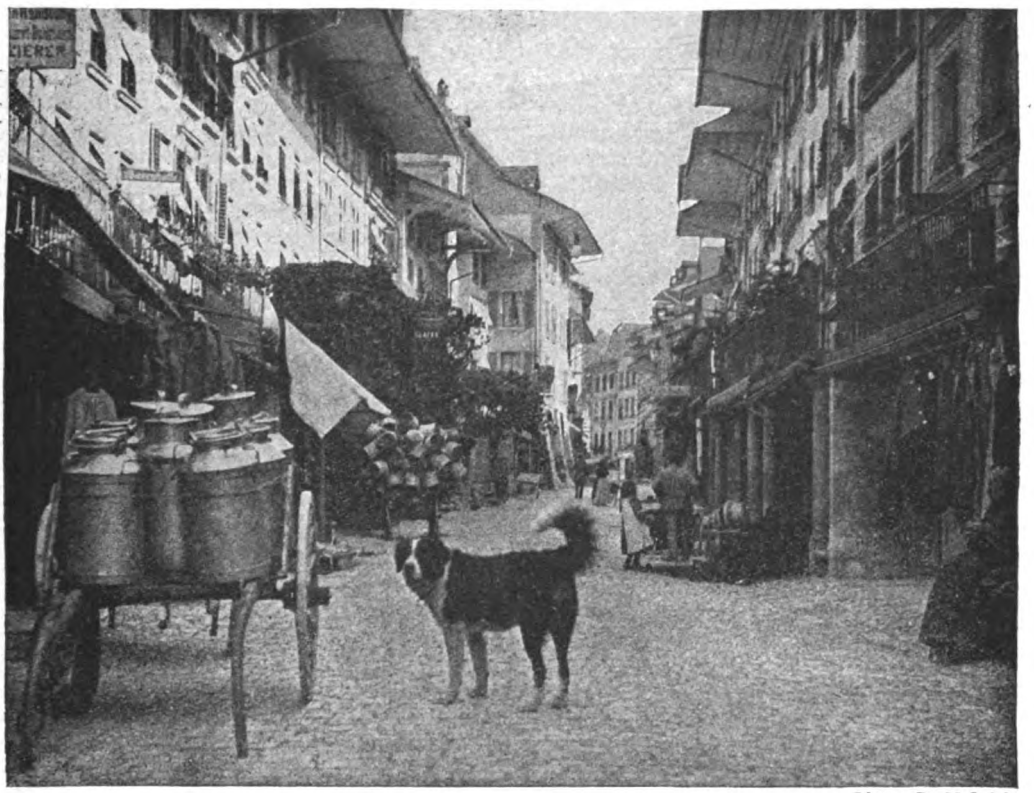


Photo: D. McLeish.

THUN.

The high street in a delightful old-world town in the Bernese Oberland. The Swiss, apart from their "trade" in tourists, are largely a pastoral people; watchmaking is probably their most important industry.

her forests. A certain amount of general agriculture is carried on, chiefly by peasant proprietors on rather a small scale. The climate refuses to grow many of the fruits which flourish in the south of England, but cherries, gooseberries and similar growths flourish, and are exported to England. The whortleberry is gathered in great quantities on the mountain sides, and this fruit is sent to England as well, the chief consignments being marketed at Hull.

The Norwegian fisheries are important, and the numerous varieties of fish caught form a large part of the nation's food. Ship-building is the chief manufacture, but the water-power of the numerous rapid streams is now being utilised, with the result that many new factories are being established.

The products of Sweden are very similar to those of Norway. The less mountainous nature of the country renders the agricultural area proportionately greater. The fisheries, on the other hand, are not equal in importance to those of Norway. The lumber industry is the source of the greatest revenue, while Swedish iron enjoys a well-deserved reputation for quality. A small amount of livestock is exported.

Undeveloped Russia

Most of the great areas of Russia are devoted to pastoral and agricultural produce. In the west and in parts of the south, wheat and the other cereals are grown in enormous quantities, while tobacco, flax and sugar-beet are also produced. Certain territories of Russia are inclined to be barren, and the lands of the far north are for the most part a frozen waste. Nevertheless, vast grazing expanses exist, especially in the south, where cattle, sheep and horses are very extensively bred. It should be noted, too, that the result of dairy-farming in Russia yields almost as great a financial return as the wheat and cereals.

The forest products of Russia are very valuable, the exports of timber to Great Britain alone amounted before the war to almost nine millions sterling in the course of the year, while the petroleum wealth of the south-east is of great importance. But this, as well as the gold and platinum of the Ural Mountains has already been referred to.

One of the most remarkable products of the Russian fisheries is that curious fish, the sturgeon, the roe of which, known as caviare, is esteemed as a delicacy all over the world.

As regards manufactures it may be said that Russia, considering her population and great resources, is still in her infancy. No manufactured goods are exported to an extent in any way comparable with that of the raw materials and dairy produce. The principal manufacture is leather. Both in this and in the making of sheet iron the Russians excel. Beyond this there is a certain amount of metal and textile work, and, of course, some general manufactures in the larger cities.

The products of the various states which now represent the old empire of Austria-Hungary are very varied—as, perhaps, is only natural when the varied territories and races comprising them are taken into consideration. Among natural resources, in addition to numerous other minerals, are the great salt mines near Cracow. Timber, too, forms an important asset.

The principal area of agriculture is that of the Plain of Hungary, where cereals are grown in the greatest abundance. In the southern regions the orange, lemon, and olive flourish, while of the numerous wines produced, the finest vintage is that of Tokay.

The principal manufacture is that of glass, Prague being one of the chief centres of this industry, which is an oldstanding one.

The Balkans

From the point of view of products the Balkan countries of Rumania, Jugo-Slavia and Bulgaria may be taken together. None of these countries is much concerned with manufactures, if cigarettes, attar of roses, and a few textiles be excepted. Many areas, however, are very fertile, and a considerable amount of agriculture and live-stock breeding is carried on. The petroleum fields of Rumania have been mentioned.

The products of Greece are very similar to those of the Balkan countries, cereals (including maize), tobacco, olives and grapes being the chief agricultural assets. The grape industry is the most important in the country, and great quantities of currants are exported as well as wine. Much olive oil is produced, and among the minerals are some fine qualities of marble. The manufactures are of minor importance, the chief being silk, hardware and leather.

The last country that remains to be dealt with is Italy. The wealth of Italy is in the main agricultural; cereals abound; from the commercial point of view some of the chief fruits are the orange, olive, lemon and grape. The wine production of Italy, as a matter of fact, is very large, although the finer qualities do not compare with the best vintages of France, Spain and Portugal.

W. H. K.

Continued from page 422.

MATHEMATICS:

Contributor: — ARITHMETIC, ALGEBRA, GEOMETRY, CO-ORDINATE GEOMETRY, TRIGONOMETRY, MECHANICS, MENSURATION, ETC.
(M. A. Lewenz, M.A.[Lond.]).

MECHANICS.—XV

91. Centre of Gravity.

A rigid body is supposed to be made up of a very great number of infinitely small particles. Its mass is the sum of the masses of these particles, and its weight is due to the force of gravity acting on each of these particles and is equal to the sum of the weights of all the particles.

Thus if m_1, m_2, m_3 . . . be the masses of the different particles, M the mass of the whole body and W its weight, then

$M = m_1 + m_2 + m_3 + \ldots\ldots$

$W = m_1 g + m_2 g + m_3 g + \ldots\ldots = (m_1 + m_2 + m_3 \ldots\ldots)g.$

Now the force of attraction due to gravity acts towards the earth's centre; and since the earth's centre is about 4,000 miles from the surface, and the distance between the particles is infinitesimally small, the forces acting on the individual particles may be considered parallel.

In § 79 it was indicated how to find the resultant of a number of like parallel forces, and it is easy to show[1] that, if forces equal to these act at the same points and are all like and parallel, but act in a different direction from that of the original forces, the resultant of this second lot of forces cuts the resultant of the original set of forces at a point called the **centre** of parallel forces. As long as the forces remain equal in magnitude to the first set of forces, act at the same points and are like and parallel, their resultant will always pass through this point. In other words, the position of the centre of parallel forces is independent of the direction of the forces.

Now when the forces considered are gravitation forces, this point in the body is called the **centre of gravity.** By what has been said it is clear that the position of the centre of gravity would remain unaltered if the direction of gravity were changed, that is to say, the centre of gravity is unaltered if the position of the body is changed. This fact affords a means of determining the centre of gravity of a body experimentally.

If a body is in equilibrium its centre of gravity must be supported. Now suppose we hang up a body by a string, then the tension in the string must balance the resultant of the gravitation forces, and must therefore act in a line passing through the centre of gravity. Next we hang up the body in a different position, and clearly the point where the first line of the string and the second intersect will be the centre of gravity of the body.

Suspend a body A B C D from the point A. Then the straight line A X must pass through the centre of gravity.

Next suspend the body from the point B. Then the straight line B Y must pass through the centre of gravity. Now B Y cuts A X at G, hence G is the centre of gravity of the body.

Since the gravitation forces acting on the particles of a body have a resultant passing through the centre of gravity, the effect of gravity on the body

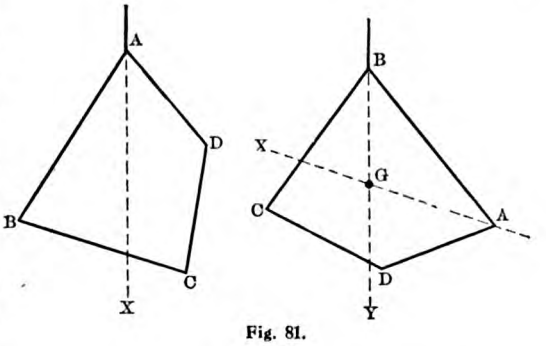


Fig. 81.

is the same as its effect on a single particle placed at the centre of gravity and having a mass equal to the mass of the whole body. Hence we may consider that the weight of a body acts at its centre of gravity.

92. Disregarding weight, let us consider the mass of a body. If a number of like parallel forces act on the body, each force being proportional to the mass of the particle on which it acts, these forces would have a centre, and since the forces are proportional to the masses of the particles, this point is called the **centre of mass.**

Clearly the centre of gravity and the centre of mass coincide.

93. *To find the centre of mass, or centre of gravity of two particles.*

Let A and B be two particles of masses m_1 and m_2 respectively.

If A and B are acted on by parallel forces, such as the force of gravity.

[1] The student can prove this graphically for himself.

Then the force on A is its weight, i.e. $m_1 g$ and the force on B is $m_2 g$.

The resultant of these is a force $(m_1 + m_2)g$ acting at a point G in A B such that $m_1 g \times A G = m_2 g \times B G$

hence $\frac{A G}{B G} = \frac{m_2 g}{m_1 g} = \frac{m_2}{m_1}$.

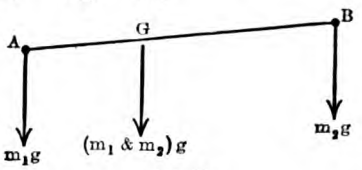


Fig 82.

This determines the position of G, the centre of mass.

If w_1 and w_2 be the weights of the particles, their whole weight $w_1 + w_2$ may be supposed to act at G and their whole mass $m_1 + m_2$ may be supposed to be concentrated at that point.

94. In finding the centre of mass of different bodies, we shall assume that these bodies are homogeneous, that is, that the matter is evenly distributed throughout the body, and in consequence that the mass is proportional to the volume.

In speaking of the centre of mass of a line, we do not mean a geometric line, but a very thin rod of uniform section and density.

Similarly, in speaking of the centre of mass of a surface, we do not mean a geometric surface, but a very thin lamina or plate of uniform thickness and density.

In both these cases the thickness is supposed to be so infinitesimally small that it can be neglected.

If a body be symmetrical about a plane, or a surface be symmetrical about a line, the centre of mass will clearly lie in that plane or that line. Now the mass of a uniform body is evenly distributed about its centre of mass, hence we have the following results for symmetrical bodies:

(1) The centre of mass of a straight line is its middle point.

(2) The centre of mass of a circle, or of its circumference or of a sphere, or of a spherical shell, is the centre of the circle or sphere.

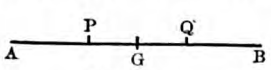


Fig. 83.

(3) The centre of mass of a parallelogram or of its perimeter is the point of intersection of the diagonals of the parallelogram.

(4) The centre of mass of a cylinder or of its surface is the middle point of its axis.

(5) The centre of mass of a cube or its surface, or of a rectangular parallelepiped or its surface, is the point of intersection of the diagonals of the cube or the parallelepiped.

We will prove Nos. (1) and (3) of the above in case they should not be obvious to the student.

Let A B be a uniform rod or line and G its middle point (Fig. 83).

Take any point P in A G and a point Q in G B such that G Q = P G.

Now the centre of mass of two equal particles at P and Q is clearly G. Also since the rod is uniform, for every particle between A and G there is a particle of equal mass at an equal distance from G between G and B.

The centre of mass of each of these pairs of particles is at G, hence the centre of mass of the whole rod is at G.

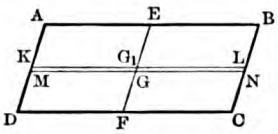


Fig. 84.

Let A B C D be a uniform parallelogram, and let E and F be the middle points of A B and D C.

Divide the parallelogram up into a number of strips by means of lines parallel to A B and D C of which K L and M N are any consecutive pair. Then if K L and M N are very close together, K L N M may be considered a uniform rod or straight line, hence its centre of mass lies at its middle point G_1, and G_1 lies on E F.

Similarly the centre of mass of all the other strips lies on E F.

Now divide the parallelogram into strips by means of straight lines parallel to B C and A D. Then the centre of mass of all these strips lies on the straight line joining the middle points of B C and A D.

Hence the centre of mass G of the whole parallelogram must lie at the point of intersection of E F and the straight line joining the middle points of B C and A D.

It is easy to prove that this point lies at the intersection of the diagonals of the parallelogram.

95. *To find the centre of mass or centre of gravity of a triangular surface.*

Let A B C be the triangular lamina and D E F the middle points of B C, C A and A B.

Suppose the triangle to be divided into a very large number of strips by means of lines parallel to B C and let K L and M N be any consecutive pair. Then if K L and M N are very close together, K L N M may be considered a uniform rod or line, and its centre of mass will be at its middle point *d*. Now *d* lies on the median A D, and similarly the centres of mass of all the other strips lie on A D.

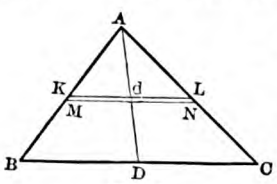


Fig. 85.

Now divide the triangle into strips by means of lines parallel to A C. Then the centre of mass of all these strips will lie on the median B E. Similarly if the triangle is divided into strips by lines parallel to A B, the centre of mass of these strips will lie on the median C F.

Hence the **centre of mass or centre of gravity G of the whole triangle lies at the point of intersection of the medians.**

96. *The centre of gravity of a triangular surface coincides with the centre of gravity of three equal particles placed at its angular points.*

Let particles of equal weights *w* be placed at A, B and C.

If D be the middle point of B C, then the resultant of w at B and w at C is $2w$ at D.

Hence the centre of gravity of the three weights w is the same as the centre of gravity of w at A and $2w$ at D.

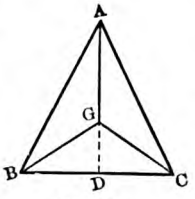


Fig. 86.

Hence it lies on A D and similarly it lies on the other medians of the triangle A B C, therefore it lies at G, the point of intersection of the medians.

Again G is the point of application of the resultant of w at A and $2w$ at D

$\therefore\ w \cdot AG = 2w \cdot GD \therefore AG : GD = 2w : w = 2 : 1$

$\therefore\ GD = \frac{1}{3} AD$ and $AG = \frac{2}{3} AD$.

Hence G is the point of trisection of any median, lying farthest from the corresponding vertex.

97. *To find the centre of mass or centre of gravity of the perimeter of a triangle.*

Let A B C be the triangle and D, E, F the middle points of B C, C A, A B.

Then the centres of gravity of the rods B C, C A and A B lie at D, E and F.

Hence the centre of gravity of the three rods is the centre of gravity of particles of weights, w_1, w_2, w_3 placed at D, E and F where w_1 = weight of B C, w_2 = weight of C A and w_3 = weight of A B.

And since the rods are uniform $w_1 : w_2 : w_3 =$ B C : C A : A B.

Hence the centre of gravity of the rods A B, A C is a point K on E F such that

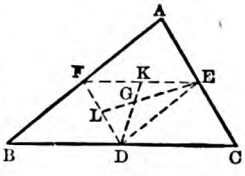


Fig. 87.

E K : K F = $w_3 : w_2$ = A B : A C = E D : D F (since triangles A B C, D E F are similar)

$\therefore$ K lies on the line bisecting the angle E D F.

Also the centre of gravity of the three rods must lie on D K.

Similarly the centre of gravity of the three rods must lie on E L where E L bisects angle D E F.

Hence the **centre of gravity of the three rods lies at G, the point of intersection of the bisectors of the angles of the triangle D E F.**

G also is the centre of the inscribed circle of triangle D E F.

98. *Having given the weights and centres of gravity of different parts of a body, to find the centre of gravity of the whole.*

Suppose A is the centre of gravity of part 1 weighing w, B, C and D the centres of gravity of parts 2, 3 and 4 respectively, weighing w_2, w_3 and w_4 respectively.

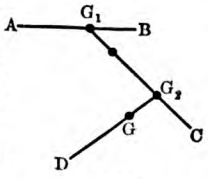


Fig. 88.

Weights w_1 and w_2 may be taken to act at A and B.

Their resultant is $(w_1 + w_2)$ acting at G_1, where $AG_1 : G_1B = w_2 : w_1$. The resultant of $(w_1 + w_2)$ acting at G_1 and w_3 acting at C is $(w_1 + w_2 + w_3)$ acting at G_2 where $G_1G_2 : G_2C = w_3 : w_1 + w_2$.

Again the resultant of $(w_1 + w_2 + w_3)$ acting at G_2 and w_4 acting at D is $(w_1 + w_2 + w_3 + w_4)$ acting at G where $G_2G : G_2D = w_4 : w_1 + w_2 + w_3 + w_4$.

Hence G is the centre of gravity of the whole body made up of the 4 parts.

Similarly the centre of gravity may be found where there are more than 4 parts.

Example :—

(1) *To find the centre of gravity of a lamina made up of two rectangles.*

Let A B C D E F H K be the lamina.

Let G_1 be the centre of gravity of the part A C of weight W_1, and G_2 the centre of gravity of the part E H of weight W_2.

Then the centre of gravity of the whole is the point G in the straight line G_1G_2 where $G_1G : GG_2 = W_2 : W_1$.

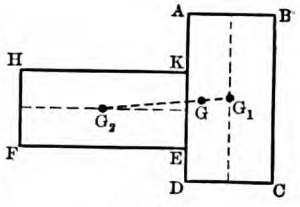


Fig. 89.

The centre of gravity of any quadrilateral may be found by first finding the centres of gravity of the two triangles which compose it.

Similarly the centre of gravity of any polygon may be found by dividing the polygon into triangles.

99. *To find the centre of gravity of part of a body, having given the weight and centre of gravity of the whole, and also the weight and centre of gravity of the part removed from it.*

Let W be the weight of the whole and C_1 its centre of gravity.

Let w be the weight of the part removed and C_2 its centre of gravity.

Let G be the centre of gravity of the remaining part.

To find the position of G.

The weight of the remaining part is $W - w$ and it acts at G.

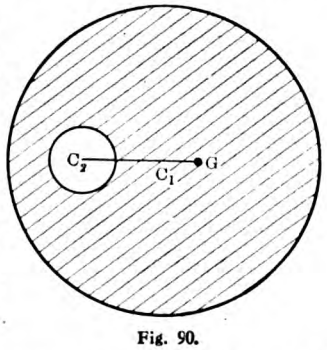


Fig. 90.

Since C_1 is the centre of gravity of the whole body C_1 must be the centre of gravity of w at C_2 and $W - w$ at G

$\therefore$ C_2, C_1 and G lie on a straight line, and

$w \times C_1G = (W - w) \times C_2C_1$

$\therefore$ G lies on C_2C_1 produced through C_1 so that

$$C_1G = \frac{W - w}{w} C_2C_1.$$

100. *To find the centre of gravity of a number of weights hung in a straight line.*

This is equivalent to finding the centre of parallel forces acting at points in a straight line.

Let W_1, W_2, W_3 . . . be weights acting at A, B, C . . . .

Let x_1, x_2, x_3 . . . . be the distances of A, B, C . . . from any point O in the straight line.

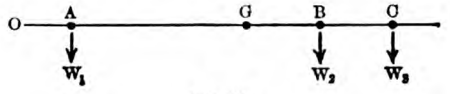


Fig. 91.

The resultant of all the forces acts at G.

Let x be the distance of G from O, then taking moments about O we have

$$W_1x_1 + W_2x_2 + W_3x_3 + \ldots = (W_1 + W_2 + W_3 + \ldots)x$$

$$\therefore \bar{x} = \frac{W_1x_1 + W_2x_2 + W_3x_3 + \ldots}{W_1 + W_2 + W_3 + \ldots}$$

101. Examples:—

(1) A uniform wire, 10 inches long, is bent so as to consist of two pieces at right angles to each other; one of these pieces is 3 in. long and the other 7 in. Find the perpendicular distance of the centre of mass of the system from the two portions of wire. (Lond. Matric. Exam.)

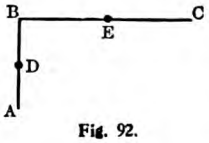


Fig. 92.

Let A B C be the piece of wire of mass m.

Let D and E be the middle points of A B, B C respectively.

Then we may consider the system as consisting of a particle of mass $\frac{3}{10}m$ at D and a particle of mass $\frac{7}{10}m$ at E.

The centre of mass will lie at G, a point on the straight line D E.

Now if $\bar{x}$ be the perpendicular distance of G from A B

$$\bar{x} = \frac{\frac{3}{10}m \times 0 + \frac{7}{10}m \times BE}{\frac{3}{10}m + \frac{7}{10}m}$$

$$= \frac{7}{10}BE = \frac{7}{10} \times \frac{7}{2} \text{ in.} = \frac{49}{20} \text{ in.}$$

Again if $\bar{y}$ be the perpendicular distance of G from B C

$$\bar{y} = \frac{\frac{3}{10}m \times BD + \frac{7}{10}m \times 0}{\frac{3}{10}m + \frac{7}{10}m}$$

$$= \frac{3}{10} \times BD = \frac{3}{10} \times \frac{3}{2} \text{ in.} = \frac{9}{20} \text{ in.}$$

(2) The top and bottom of a cubical wire cage of 12 cms. side are made of gauze weighing 20 grams per sq. dcm. Two sides meeting in a common edge are made of gauze weighing 10 grams per sq. dcm., and the other sides each weigh 30 grams per sq. dcm. Find the centre of gravity of the cage. (Lond. Matric. Exam.)

Let A B C D be a cross section of the cage parallel to the top and the bottom, and let E be the point of intersection of A C and B D. Further let A B C D be midway between the top and the bottom (Fig. 93).

Then since the top and the bottom are made of the same gauze, are equal in area and are equidistant from A B C D, their centre of gravity will lie at E.

Let A B and B C be lines on the sides made of gauze weighing 10 grams per sq. dcm.
and C D and D A lines on the sides made of gauze weighing 30 grams per sq. dcm.

Let F, H, K and L be the middle points of A B, B C, C D and D A respectively, and let F H and K L cut B D at M and N, the middle points of F H and K L respectively.

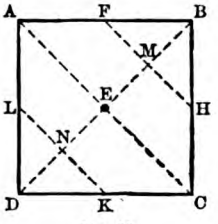


Fig. 93.

Then F, H, K and L are also the middle points and hence the centres of gravity of the four sides on which A B, B C, C D and D A respectively lie.

Now as the sides are all equal, the weights of the sides will be proportional to the weight of the gauze of which each is made, hence the system is equivalent to:

A weight of 2 × 20 at E
A weight of 10 at F and a weight of 10 at H
A weight of 30 at K and a weight of 30 at L

The weights at F and H are equivalent to a weight of 20 at M
and the weights at K and L are equivalent to a weight of 60 at N.

Hence we have to find G, the centre of gravity of weights 60, 40 and 20 at N, E and M respectively in the line D B.

Let $\bar{x}$ be the distance of G from D.

$$\text{Then } \bar{x} = \frac{60 \times DN + 40 \times DE + 20 \times DM}{60 + 40 + 20}$$

Now $DN = \frac{1}{4}DB$, $DE = \frac{1}{2}DB$ and $DM = \frac{3}{4}DB$

$$\therefore \bar{x} = \frac{(15 + 20 + 15)DB}{120} = \frac{5}{12}DB.$$

But $DB = \sqrt{288} = 12\sqrt{2}$ cm.

$\therefore \bar{x} = 5\sqrt{2}$cm. which gives the position of G on D B.

Exercise 16

Find the centre of gravity of

(1) Two heavy particles weighing 10 lb. and 26 lb. which are 4 ft. 6 in. apart.

(2) Two spheres weighing 12 lb. and 10 lb. whose centres are 4 ft. 7 in. apart.

(3) A cubical box without a lid, the length of whose side is x.

(4) A hollow sphere[1] 3 ft. in diameter containing a spherical cavity, 1 ft. in diameter whose centre is 8 in. distant from the centre of the sphere.

(5) A telescope consisting of two cylinders[2], the radius of one of which is 4 in., and its length 6 in.; the radius of the other is 3 in. and its length 8 in.

---

[1] Volume of a sphere $= \frac{4}{3}\pi r^3$ where r = radius and $\pi = \frac{22}{7}$.

[2] Volume of a cylinder $= 2\pi rh$, where r = radius of circular surface, h = length, $\pi = \frac{22}{7}$.

(6) The remainder of a square of side a, when one of the triangles formed by the diagonals has been removed.

(7) A heavy wire bent in the form of a right angle, having one arm twice the length of the other, and having a mass equal to half the mass of the whole wire fixed at the angular point.

Key to Exercise 15

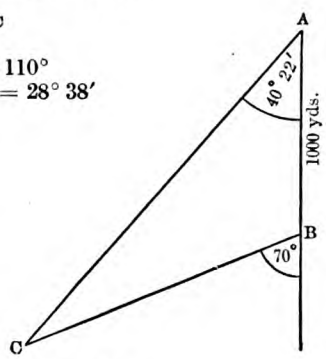
(1) $2\sqrt{2}$ P acting parallel to C A at a distance $\frac{3}{4}$ C A from it on the same side as D. (2) 20 lb. (3) 120 lb. (4) 5 feet from the heavier weight. (5) $10\sqrt{2}$ and 10 lb. wt. (6) 45°

M. A. L.

TRIGONOMETRY.—IX

78. Practical applications.

(1) A and B are points on a straight road, 1,000 yards apart, and A is due north of B. A church spire C bears S. 70° W. at B and S. 41° 22′ W. at A. Find the distance from A to C.



In triangle A B C
A B $= c = 1000$
B $= 180° - 70° = 110°$
C $= 70° - 41° 22′ = 28° 38′$
A C $= b$

$$b = \frac{c \sin B}{\sin C}$$

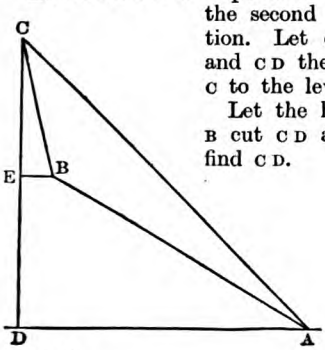
$\therefore \log b = \log c + \log \sin B - \log \sin C$
$= 3 + \bar{1}\cdot 9729858 - \bar{1}\cdot 6805191$
$= 3\cdot 2924667$
$= \log 1960\cdot 95$

Hence A C $=$ **1960·95 yds.**

(2) The altitude of a hill-top is observed to be 47°, and after walking 1,000 ft. towards the hill up a slope inclined at an angle of 32° to the horizon, the altitude is found to be 77°. Find the vertical height of the hill-top above the first point of observation.

Let A be the first point of observation, and B the second point of observation. Let C be the hill-top, and C D the vertical line from C to the level of A.

Let the horizontal line from B cut C D at E. Required to find C D.



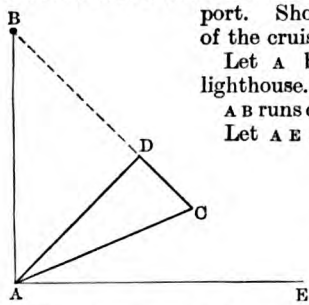
A B $= 1000$ ft.
B A D $= 32°$,
B A C $= 47° - 32° = 15°$, A C D $= 90° - 47° = 43°$
B C E $= 90° - 77° = 13°$, B C A $= 43° - 13° = 30°$, A B C $= 180° - 15° - 30° = 135°$

$$\frac{AC}{\sin ABC} = \frac{AB}{\sin BCA} \quad \therefore AC = AB \cdot \frac{\sin ABC}{\sin BCA}$$

$$= 1000 \frac{\sin 135°}{\sin 30°} = 1000 \times \frac{1}{\sqrt{2}} \times 2 = 1000\sqrt{2}$$

C D $=$ A C . sin C A D $= 1000\sqrt{2} \times \sin 47°$
$\therefore \log$ C D $= \log 1000 + \frac{1}{2}\log 2 + \log \sin 47°$
$= 3 + \cdot 1505150 + \bar{1}\cdot 8641275$
$= 3\cdot 0146425 = \log 1034\cdot 3$
$\therefore$ C D $=$ **1034·3 ft.**

(3) A lighthouse stands 9 miles due N. of a port from which a yacht sails in a direction E.N.E. until the lighthouse is N.W. of her, when she tacks and sails towards the lighthouse until the port is S.W. of her, when she tacks again and sails into port. Show that the length of the cruise is 16 miles nearly.



Let A be the port, B the lighthouse.
A B runs due N. and $= 9$ miles.
Let A E run due east.
The yacht sails to C and C A E $= 22\frac{1}{2}°$, C B A $= 45°$. From C she sails to D in the straight line C D, and D A B $= 45°$.

Since D A B $=$ D B A $= 45° \therefore$ D B $=$ D A and A D B $= 90°$

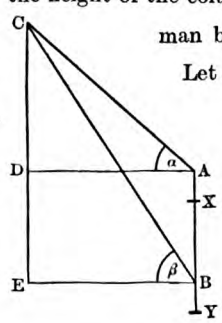
$$DA = AB \sin 45° = 9 \frac{\sqrt{2}}{2} \text{ miles} = 6\cdot 4 \text{ miles}$$

approximately.
Now, D A C $= 22\frac{1}{2}° \therefore$ A C D $= 67\frac{1}{2}°$

$$AC = \frac{AD}{\sin 67\frac{1}{2}°} \therefore \log AC$$

$= \log$ A D $- \log \sin 67\frac{1}{2}°$
$= \log 9 + \frac{1}{2}\log 2 - \log 2 - \bar{1}\cdot 9656153$
$= \cdot 9542425 - \cdot 1505150 = \bar{1}\cdot 9656153$
$= \cdot 8381122 = \log 6\cdot 88884$
$\therefore$ A C $= 6\cdot 9$ miles approximately.
Again, D C $= \sqrt{(6\cdot 9)^2 - (6\cdot 4)^2} = \sqrt{6\cdot 67} = 2\cdot 6$
The length of the cruise $=$ A D $+$ D C $+$ C A $= 6\cdot 9 + 6\cdot 4 + 2\cdot 6$ miles $=$ **15·9 miles,** i.e. nearly 16 miles.

(4) A man stands on top of a wall of height h and observes the angular elevation α of the top of a column; he then descends from the wall and finds that the angular elevation is β. Prove that the height of the column exceeds the height of the man by $h \dfrac{\sin \beta \cos \alpha}{\sin (\beta - \alpha)}$.



Let X Y be the wall, A X the man standing on the wall, and B Y his position when he has descended.

Then since A X $=$ B Y, A B $=$ X Y $= h$.

Let C be the top of the column and A D, B E horizontal lines drawn to the column from A and B.

Then C E = excess of the height of the column over the height of the man.

C A D = α, C B E = β

C E = E B tan β, C D = A D tan α

D E = A B = h, and A D = E B

D E = C E − C D

$\therefore h$ = E B tan β − E B tan α

$$\therefore \text{E B} = \frac{h}{\tan\beta - \tan\alpha}$$

Now, C E = E B tan β

$$\therefore \text{C E} = \frac{h\tan\beta}{\tan\beta - \tan\alpha} = \frac{h\sin\beta\cos\alpha}{\sin(\beta-\alpha)}$$

Exercise 16

(1) The angular elevation of a tower at a place A due south of it is 30° ; and at a place B due west of A, and at a distance a from it, the elevation is 18°. What is the height of the tower ?

(2) A column stands at the foot of an inclined plane whose inclination to the horizon is 9° ; a line of 100 feet is measured up the incline from the foot of the column. At the upper extremity of this line the column subtends an angle of 54°. Find the height of the column L sin 54° = 9·9079576.

(3) On either side of a road stand two parallel hills, each sloping up at an angle of 30°. A man walks 200 yards straight up one hill from the road, and finds that the angle of elevation of the other hill above the horizon is 15°. Show that the height of the observed hill is nearly 273 yards.

(4) A man whose eye is h feet above the surface of a lake finds that the angle of elevation of a point on a cloud is β, and the angle of depression of the reflection of the same point in the lake is α. Find the height of the cloud above the surface of the lake.

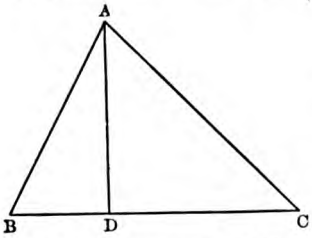
(5) Two lines of straight railway, A B C, D E C, meet at C, telegraph posts being situated at A, B, D and E ; the angles D A E, D B E are each equal to α ; the angles E A B, E B C are β and γ respectively. Show that

$$\text{B C} = \text{A B}\,\frac{\sin\beta\sin(\alpha+\beta)}{\sin(\gamma-\beta)\sin(\alpha+\beta+\gamma)}$$

(6) The angles of elevation of the top of a tower on a horizontal plane, observed at two points distant a and b feet respectively from the base and in the same straight line with it, are found to be complementary. Show that the height of the tower is $\sqrt{a\,b}$ feet. If θ be the angle subtended at the top of the tower by the line joining the two points, show that $\sin\theta = \dfrac{a-b}{a+b}$.

Triangles, Circles and Polygons.

79. *To find the area of a triangle.*

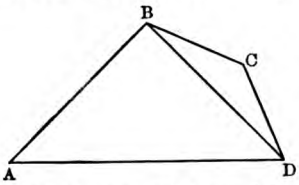


Area of △ A B C
= ½ A D . B C
= ½ A B sin B . B C if B be acute or right,
or = ½ A B sin (π − B) . B C if B be obtuse or right,
= ½ $c\,a$. sin B in every case.

Similarly, area = ½ $a\,b$ sin C = ½ $b\,c$ sin A.

Again, area
= ½ $c\,a$ sin B
$$= \tfrac{1}{2}\,c\,a \times 2\,\frac{\sqrt{s(s-a)(s-b)(s-c)}}{c\,a}$$
$$= \sqrt{s(s-a)(s-b)(s-c)} = S$$

80. *To find the area of a quadrilateral in terms of its sides and two opposite angles.*



If a, b, c and d denote the length of the sides A B, B C, C D, D A respectively of the quadrilateral A B C D, and s the semiperimeter, then

(1) If the quadrilateral be cyclic,

Area of A B C D
= △ A B D + △ B C D
= ½ $a\,d$ sin A + ½ $b\,c$ sin (π − A)
= ½ ($a\,d + b\,c$) sin A

Again, B D² = $a^2 + d^2 - 2\,a\,d\cos$ A
= $b^2 + c^2 - 2\,b\,c\cos(\pi - \text{A})$
= $b^2 + c^2 + 2\,b\,c\cos$ A

$$\therefore 2(a\,d + b\,c)\cos\text{A} = a^2 + d^2 - b^2 - c^2$$

$$\therefore \sin^2\text{A} = 1 - \frac{(a^2+d^2-b^2-c^2)^2}{4(a\,d+b\,c)^2}$$

$$= \frac{(2\,a\,d + 2\,b\,c + a^2 + d^2 - b^2 - c^2)(2\,a\,d + 2\,b\,c - a^2 - d^2 + b^2 + d^2)}{4(a\,d+b\,c)^2}$$

$$= \frac{(a+d+b-c)(a+d-b+c)(b+c+a-d)(b+c-a+d)}{4(a\,d+b\,c)^2}$$

$$= \frac{4(s-c)(s-b)(s-d)(s-a)}{(a\,d+b\,c)^2}$$

$\therefore$ area of A B C D =
$\sqrt{\{(s-a)(s-b)(s-c)(s-d)\}}$

(2) If the quadrilateral be not cyclic,

Let A = $\theta + \alpha$ and C = $\theta - \alpha$

Then A + C = θ.

Let P = area of A B C D

Then P = △ A B D + △ B C D = ½ $a\,d$ sin ($\theta + \alpha$) + ½ $b\,c$ sin ($\theta - \alpha$)

$\therefore$ 2 P = $a\,d$ sin ($\theta + \alpha$) + $b\,c$ sin ($\theta - \alpha$)
= ($a\,d + b\,c$) cos α sin θ − ($b\,c - a\,d$) sin α cos θ (1)

Again, B D² = $a^2 + d^2 - 2\,a\,d\cos(\theta + \alpha)$
= $b^2 + c^2 - 2\,b\,c\cos(\theta - \alpha)$

$\therefore$ ($b\,c - a\,d$) cos α cos θ + ($a\,d + b\,c$) sin α sin θ
= ½ ($b^2 + c^2 - a^2 - d^2$) ..... (2)

Squaring (1) and (2) and adding we get

($a\,d + b\,c$)² sin² θ + ($b\,c - a\,d$)² cos² θ = 4 P²
+ ¼ ($b^2 + c^2 - a^2 - d^2$)

$\therefore$ 4 P² = $a^2\,d^2 + b^2\,c^2 - 2\,a\,b\,c\,d$ (2 cos² θ − 1)
− ¼ ($b^2 + c^2 - a^2 - d^2$)

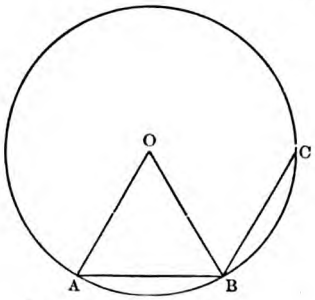
$\therefore$ 16 P² = 4 ($a\,d + b\,c$)² − ($b^2 + c^2 - a^2 - d^2$)
− 16 $a\,b\,c\,d$ cos² θ
= ($b + c + a - d$) ($b + c - a + d$) ($a + d + b - c$)
($a + d - b + c$)
− 16 $a\,b\,c\,d$ cos² θ

$\therefore$ P = $\sqrt{\{(s-a)(s-b)(s-c)(s-d) - a\,b\,c\,d\cos^2\theta\}}$

81. *To find the area of a regular polygon inscribed in a given circle.*

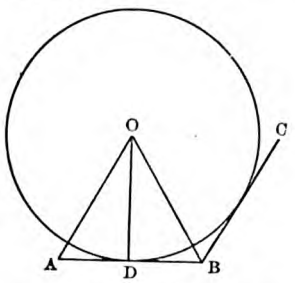
Let A B C . . . . be a regular polygon of n sides inscribed in the given circle, centre O and radius r.

Join O A, O B. Then angle A O B $= \frac{2\pi}{n}$



Area of polygon
$= n \times$ area of $\triangle$ A O B
$= n \times \frac{1}{2}$ O A . O B . sin A O B
$= n \times \frac{1}{2} r^2 \sin \frac{2\pi}{n}$
$= \frac{1}{2} nr^2 \sin \frac{2\pi}{n}$

82. *To find the area of a regular polygon circumscribed about a given circle.*



Let A B C . . . . be a regular polygon of n sides described about the given circle, centre O, radius r.

Let D be the point of contact of A B with the circle.

Join O A, O B, O D. Then angle A O D $= \frac{\pi}{n}$

Area of polygon
$= n \times$ area of triangle A O B
$= n \times \frac{1}{2}$ O D . A B $= n \times \frac{1}{2} r \times 2r \tan \frac{\pi}{n}$.
$= nr^2 \tan \frac{\pi}{n}$:

83. *To find the radius of the circle circumscribing a triangle.*

Let R be the radius of the circle circumscribing triangle A B C.

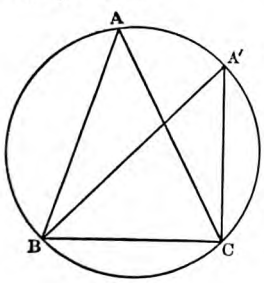


Fig. 1.

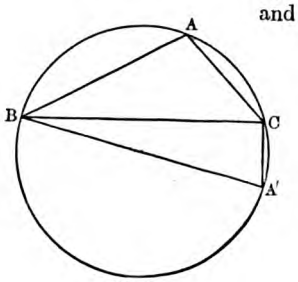


Fig. 2.

Draw the diameter B A′. Join A′ C.

In Fig. 1 angle B A C = angle B A′ C as they are in the same segment.

In Fig. 2 angle B A C is the supplement of angle B A′ C since B A C A′ is a cyclic quadrilateral.

Also, angle B C A′ is a right angle as it is an angle in a semicircle.

Hence $\frac{\text{C B}}{\text{A}' \text{B}} = \sin \text{B A}' \text{C} = \sin \text{B A C} = \sin \text{A}$

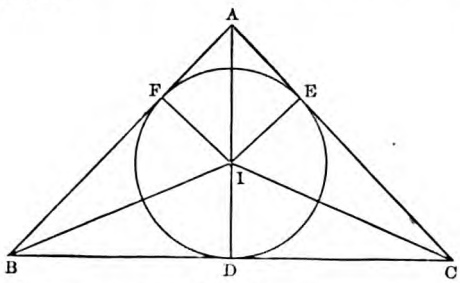
$\therefore 2\text{R} = \frac{\text{C B}}{\sin \text{A}} = \frac{a}{\sin \text{A}} = \frac{b}{\sin \text{B}} = \frac{c}{\sin \text{C}}$

Hence $\text{R} = \frac{1}{2} \frac{a}{\sin \text{A}} = \frac{1}{2} \frac{b}{\sin \text{B}} = \frac{1}{2} \frac{c}{\sin \text{C}}$

Or in terms of the sides, since $\sin \text{A} = \frac{2S}{bc}$

$$\text{R} = \frac{abc}{4S}$$

84. *To find the radius of the circle inscribed in a triangle.*



Let A B C be the triangle, I the centre of the inscribed circle, and D, E, F its points of contact with B C, C A, A B respectively.

Then I is the point where the bisectors of the angles A, B and C meet.

Let r be the radius of the circle.

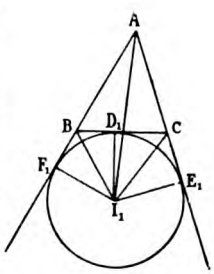
$\triangle$ A B C $= \triangle$ A I B $+ \triangle$ B I C $+ \triangle$ C I A
$= \frac{1}{2}$ A B . I F $+ \frac{1}{2}$ B C . I D $+ \frac{1}{2}$ C A . I E

Now, I F = I D = I E = r

$\therefore \frac{1}{2} r(a + b + c) =$ area of A B C $= S$

$\therefore rs = S \therefore r = \frac{S}{s}$

85. *To find the radius of a circle escribed to a triangle.*



Let A B C be the triangle, I_1 the centre of an escribed circle, D_1, E_1, F_1 its points of contact with B C and A C, A B produced respectively.

Then I_1 is the point where the bisectors of angles C B F_1 and B C E_1 meet. Let r_1 be the radius of the circle.

Then $\text{I}_1 \text{F}_1 = \text{I}_1 \text{D}_1 = \text{I}_1 \text{E}_1 = r_1$. Join A I_1

$\triangle$ A B C
$= \triangle \text{I}_1 \text{C A} + \triangle \text{I}_1 \text{B A} - \triangle \text{B I}_1 \text{C}$
$= \frac{1}{2}$ C A . $\text{I}_1 \text{E}_1 + \frac{1}{2}$ A B . $\text{I}_1 \text{F}_1$
$- \frac{1}{2}$ B C . $\text{I}_1 \text{D}_1$

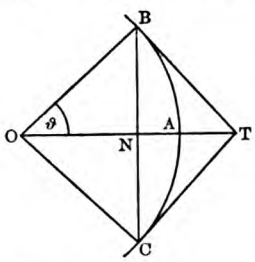
$\therefore S = \frac{1}{2} r_1 \text{C A} + \frac{1}{2} r_1 \text{A B} - \frac{1}{2} r_1 \text{B C}$
$= \frac{1}{2} r_1 (b + c - a) = r_1 (s - a)$

$\therefore r_1 = \frac{S}{s - a}$

Similarly, if r_2 and r_3 be the radii of the escribed circles touching C A and A B,

$$r_2 = \frac{S}{s-b} \text{ and } r_3 = \frac{S}{s-c}.$$

86. *If* θ *be the number of radians in an acute angle,* θ *is greater than sin* θ *but less than tan* θ.



Let A O B be the given angle, A B the arc of a circle with centre O and any radius.

Draw B N perpendicular to O A and produce it to C so that N C = B N.

Then O C = O B, and therefore the circle of which A B is an arc will pass through C.

Let B T be the tangent to the circle cutting O A produced in T.

Then C T = B T, and C T is perpendicular to O C and hence T C touches the circle at C.

Now, tangent B T + tangent C T > arc B A + arc C A > chord C B

$$\therefore \text{B T} > \text{arc A B} > \text{B N}$$

$$\therefore \frac{\text{B T}}{\text{O B}} > \frac{\text{arc A B}}{\text{O A}} > \frac{\text{B N}}{\text{O B}}$$

i.e. $\tan\theta > \theta > \sin\theta$.

87. *If* θ *be the number of radians in an acute angle, the limiting values of* $\frac{\sin\theta}{\theta}$ *and* $\frac{\tan\theta}{\theta}$, *when* θ *is indefinitely diminished, are in each case unity.*

We have $\tan\theta > \theta > \sin\theta$

$$\therefore \frac{\tan\theta}{\sin\theta} > \frac{\theta}{\sin\theta} > 1$$

$$\therefore \sec\theta > \frac{\theta}{\sin\theta} > 1$$

Now, when θ is indefinitely diminished so that it differs from zero by less than any assignable quantity, however small, $\sec\theta$ in the limit is unity.

Therefore the limit of $\frac{\theta}{\sin\theta}$ is unity, and hence also the limit of $\frac{\sin\theta}{\theta}$ is unity when θ becomes indefinitely small.

Again, $\frac{\tan\theta}{\theta} = \frac{\sin\theta}{\theta} \times \frac{1}{\cos\theta}$

And when θ is indefinitely diminished the limit of $\frac{\sin\theta}{\theta}$ is unity and the limit of $\frac{1}{\cos\theta}$ is unity, and hence the limit of $\frac{\tan\theta}{\theta}$ is unity.

88. *To find the area of a circle.*

Let regular polygons of n sides be described in and about the given circle.

Then the area of the inscribed polygon = $\frac{1}{2} nr^2 \sin\frac{2\pi}{n}$

and the area of the circumscribed polygon = $nr^2 \tan\frac{\pi}{n}$.

The area of the circle lies between these two, and when n becomes infinitely great the polygons coincide with the circle.

Now, when n is infinitely great, $\frac{2\pi}{n}$ is indefinitely small.

And when n is infinity,

$$\text{the limit of } \tfrac{1}{2} nr^2 \sin\frac{2\pi}{n} = \text{limit } \tfrac{1}{2} nr^2 \frac{2\pi}{n} \left(\frac{\sin\frac{2\pi}{n}}{\frac{2\pi}{n}} \right)$$

$$= \pi r^2 \text{ by § 87.}$$

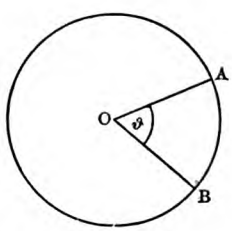
Also,

$$\text{the limit of } nr^2 \tan\frac{\pi}{n} = \text{limit of } nr^2 \frac{\pi}{n} \left(\frac{\tan\frac{\pi}{n}}{\frac{\pi}{n}} \right)$$

$$= \pi r^2 \text{ by § 87.}$$

$\therefore$ the area of the circle $= \pi r^2$.

89. *To find the area of a sector of a circle.*



Let A O B be a sector of a circle, centre O and radius r.

Then,

area of sector A O B : area of whole circle = angle A O B : 4 right angles = $\theta : 2\pi$.

$\therefore$ area of sector $= \pi r^2 \times \frac{\theta}{2\pi} = \frac{r^2\theta}{2}$.

Exercise 17

(1) Prove that each of the following expressions represents the area of a triangle A B C:—

(i) $\frac{abc}{4R}$. (ii) $2R^2 \sin A \sin B \sin C$.

(iii) rs. (iv) $Rr\,(\sin A + \sin B + \sin C)$.

(v) $\frac{1}{2}a^2 \sin B \sin C \operatorname{cosec} A$.

(vi) $ra \operatorname{cosec} \frac{A}{2} \cos\frac{B}{2} \cos\frac{C}{2}$.

(vii) $\sqrt{r \times r_1 \times r_2 \times r_3}$.

(viii) $\frac{1}{2}(a^2 - b^2) \sin A \sin B \operatorname{cosec}(A - B)$.

(ix) $\frac{1}{4}a^2 \sin 2B + \frac{1}{4}b^2 \sin 2A$.

(x) $\frac{1}{4}(a^2 \cot A + b^2 \cot B + c^2 \cot C)$.

(2) If A B C D be a cyclic quadrilateral, show that $AC^2 = \frac{(ac + bd)(ad + bc)}{ab + cd}$.

(3) If C is a right angle, show that $2r + 2R = a + b$

(4) Show that $r_2 r_3 + r_3 r_1 + r_1 r_2 = s^2$.

(5) If A B C D be a quadrilateral which can be inscribed in a circle and also circumscribed about a circle,

$$\tan^2\frac{A}{2} = \frac{bc}{ad} + \tan^2\frac{D}{2} = \frac{ab}{cd}.$$

Key to Exercise 15

(1) C = 78°, a = 28·270, b = 31·429.

(2) A = 87° 47′ 45″, b = 5980·34, c = 2807·77.

(3) a = 2993, b = 7276, c = 33° 9′ 10″.

(4) A = 63° 30′ 56″, B = 37° 58′ 20″, C = 78° 30′ 44″.

(5) A = 38° 29′ 2″, B = 66° 29′ 22″, C = 75° 1′ 36″.

(6) Triangle impossible.

Key to Exercise 16

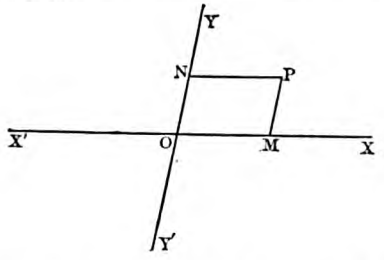
(1) $\frac{a}{\sqrt{2(1+\sqrt{5})}}$. (2) 114·4 ft.

(3) $h \sin(\alpha + \beta) \operatorname{cosec}(\alpha - \beta)$. M. A. L.

CO-ORDINATE GEOMETRY.—I

1. The Point.

The following method of determining the position of any point was introduced by Descartes. We are supposed to be given the position of two fixed straight lines X X′ and Y Y′ intersecting at a point O. Now if through any point P we draw P M, P N parallel to Y Y′ and X X′ respectively, then clearly if we know the position of P, we know the lengths of P M and P N; and on the other hand, if we know the lengths of P M and P N, the position of P is known to us.



Suppose P N $= a$ and P M $= b$; then measure O M $= a$ and O N $= b$, draw parallels to Y Y′ and X X′ through M and N; these will intersect at the given point P. The lines P M, P N are called the **co-ordinates** of the point P. Sometimes P M is called the *ordinate* and P N the *abscissa*.

The co-ordinate measured along X X′ is indicated by x, that measured along Y Y′ by y.

The point P above is determined by the equations $x = a$, $y = b$.

2. The fixed lines X X′ and Y Y′ are called the **axes of co-ordinates,** and the point O where they intersect is called the **origin.**

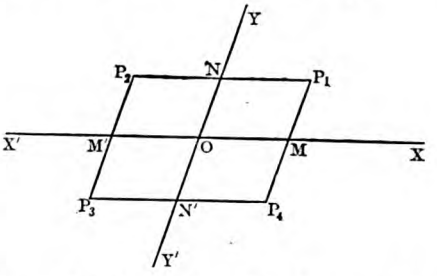
The axes are said to be rectangular or oblique according as angle Y O X is a right angle or not. Clearly the co-ordinates of the point M are $x = a$, $y = 0$; those of the point N are $x = 0$, $y = b$; while those of the origin O are $x = 0$, $y = 0$.

In order that the equations $x = a$, $y = b$ may define one point only, we must pay attention not only to the magnitude but also to the sign of the co-ordinates. By the usual algebraic convention, lengths measured in the directions O X and O Y are taken as positive, and those measured in the opposite directions, i.e. O X′ and O Y′ are taken as negative.

If we take O M $= a$ and O N $= b$, then in the accompanying figure where O M′ and O N′ $=$ O M and O N in magnitude, any of the points P_1, P_2, P_3, P_4 would satisfy the equations $x = a$, $y = b$, *if we paid no attention to the signs.*

But since O M is positive, O M′ is negative, and since O N is positive, O N′ is negative, hence the co-ordinates for the points P_1, P_2, P_3, P_4 are as follows:

$P_1 \begin{cases} x = a \\ y = b \end{cases}$, $P_2 \begin{cases} x = -a \\ y = b \end{cases}$, $P_3 \begin{cases} x = -a \\ y = -b \end{cases}$, $P_4 \begin{cases} x = a \\ y = -b \end{cases}$.



It is usual to denote the point whose co-ordinates are $x = a$, $y = b$ by "the point (a, b)," or simply "the point a, b."

Thus P_2 would be written, the point $-a, b$.

3. *To express the distance between two points in terms of their co-ordinates.*

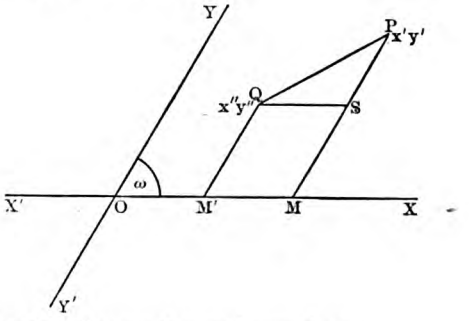
Let the axes be inclined at an angle ω.

Let the co-ordinates of the point P be x' y' and those of the point Q x'' y''.

Draw P M, Q M′ parallel to Y Y′ and Q S parallel to X X′,

then O M $= x'$, M P $= y'$

O M′ $= x''$, M′ Q $= y''$.



Now by trigonometry we know that

P Q^2 $=$ Q S^2 $+$ S P^2 $-$ 2 Q S, S P cos Q S P.

But Q S $=$ M′ M $=$ O M $-$ O M′ $= x' - x''$

and S P $=$ M P $-$ M S $=$ M P $-$ M′ Q $= y' - y''$

and angle Q S P $=$ angle O M P $= \pi - \omega$,

$\therefore$ P Q^2 $= (x' - x'')^2 + (y' - y'')^2 - 2(x' - x'')(y' - y'') \cos(\pi - \omega)$

$= (x' - x'')^2 + (y' - y'')^2 + 2(x' - x'')(y' - y'') \cos\omega$.

$\therefore$ P Q $= \pm \sqrt{\{(x' - x'')^2 + (y' - y'')^2 + 2(x' - x'')(y' - y'') \cos\omega\}}$.

If the axes be rectangular, $\cos\omega = 0$ and P Q $= \pm \sqrt{\{(x' - x'')^2 + (y' - y'')^2\}}$.

The student must be careful in applying these formulae to pay attention to the signs of the co-ordinates, otherwise the results will be incorrect.

The distance of a point P from the origin O can

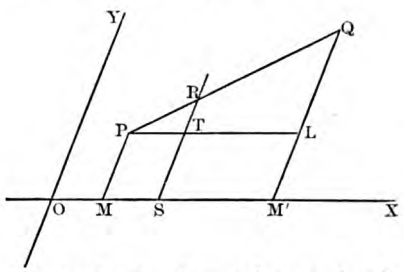
be obtained by putting $x'' = 0, y'' = 0$ in the above, and we have

$$\text{O P} = \pm \sqrt{\{x'^2 + y'^2 + 2x'y' \cos \omega\}}$$

and $\text{O P} = \pm \sqrt{\{x'^2 + y'^2\}}$.

If the distance only is required, the sign of the square root may be disregarded. If, however, we have 3 or more points, P, Q, R ..... one direction must be taken as positive and the opposite as negative, so that P Q + Q R = P R in every case.

4. *To find the co-ordinates of a point dividing in a given ratio the line joining two given points.*



Let P and Q be the given points x' y' and x'' y''. Let x, y be the co-ordinates of R. Let $m : n$ be the ratio in which the point R divides the line P Q. Draw P M, R S, Q M' parallel to the axis of Y and P T L parallel to the axis of x.

Then M S : S M' : : P T : T L : : P R : R Q : : m : n,

$\therefore n \times \text{M S} = m \times \text{S M'}$, i.e. $n \times \text{M S} - m \times \text{S M'} = 0$;

or $n(x - x') - m(x'' - x) = 0$,

$$\therefore x = \frac{nx' + mx''}{m + n}.$$

Similarly, $y = \dfrac{ny' + my''}{m + n}$.

A case of frequent occurrence is that in which R bisects P Q: the co-ordinates of the point of bisection are therefore $\dfrac{x' + x''}{2}$, $\dfrac{y' + y''}{2}$.

If P Q is cut *externally* in the ratio $m : n$ we should have M S : S M' : : m : n,

$\therefore$ M S : M' S : : m : $-(n)$,

i.e. $-n(x - x') = m(x'' - x)$, $\therefore x = \dfrac{nx' - mx''}{n - m}$

and similarly $y = \dfrac{ny' - my''}{n - m}$.

From now on the axes will be supposed to be rectangular unless otherwise stated.

Exercise 1

(1) Mark in a figure the points (i) $x = 2, y = 3$; (ii) $x = -1, y = 2$; (iii) $x = 4, y = -\frac{1}{2}$; (iv) $x = -1{\cdot}5, y = -2{\cdot}8$.

(2) Mark in a figure the points $x = -2, y = 3$ and $x = 1, y = -1$. Show that the distance between them = 5.

(3) Find the lengths of the sides of a triangle whose angular points are : $x' = 2, y' = 3$; $x'' = 4, y'' = -5$; $x''' = -3, y''' = -6$.

(4) Show that the points (o, -1), (-2, 3), (6, 7) and (8, 3) are the angular points of a rectangle.

(5) Show that if the point xy is equidistant from the points (2, 3) and (4, 5) then $x + y = 7$.

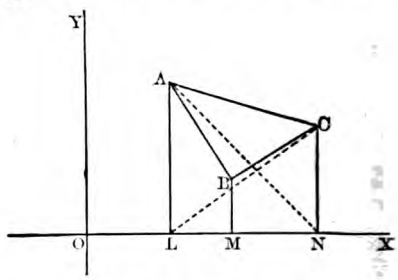
(6) Find the co-ordinates of the middle point of the line joining the points (a, b) and (a', b').

5. *To express the area of a triangle in terms of the co-ordinates of its angular points.*

Let the co-ordinates of the angular points A, B, C be x', y', ; x'', y'' ; x''', y''' respectively.

Draw A L, B M, C N parallel to the axis of y.

Now area of $\triangle$ A B C = L A C N − L A B M − M B C N.



But L A C N = $\triangle$ L A C + $\triangle$ L N C

$= \frac{1}{2}$ L N . L A + $\frac{1}{2}$ L N . N C

$= \frac{1}{2}(x''' - x')(y''' + y')$.

Again, L A B M = $\frac{1}{2}(x''' - x')(y'' + y')$

and M B C N = $\frac{1}{2}(x''' - x'')(y''' + y'')$,

$\therefore \triangle$ A B C = $\frac{1}{2}\{(x''' - x')(y''' + y') + (x' - x'')(y' + y'') + (x'' - x''')(y'' + y''')\}$

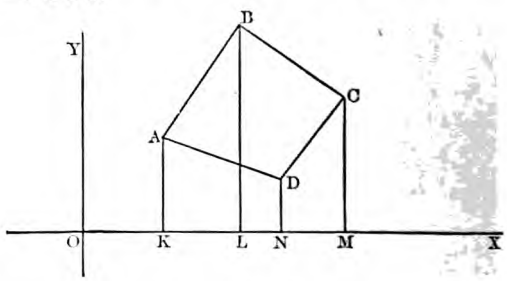
$= \frac{1}{2}\{x'y'' - x''y' + x''y''' - x'''y'' + x'''y' - x'y'''\}$.

6. *To express the area of a quadrilateral in terms of the co-ordinates of its angular points.*

Let the co-ordinates of the angular points A B C D be x_1 y_1; x_2, y_2; x_3, y_3; x_4, y_4 respectively.

Draw A K, B L, C M, D N parallel to the axis of y.

Area of A B C D = K A B L + L B C M − M C D N − N D A K.



Proceeding as before we find

K A B L = $\frac{1}{2}(x_2 - x_1)(y_1 + y_2)$

L B C M = $\frac{1}{2}(x_3 - x_2)(y_2 + y_3)$

M C D N = $\frac{1}{2}(x_3 - x_4)(y_3 + y_4)$

N D A K = $\frac{1}{2}(x_4 - x_1)(y_4 + y_1)$.

Whence A B C D = $\frac{1}{2}\{x_1y_4 - x_4y_1 + x_2y_1 - x_1y_2 + x_3y_2 - x_2y_3 + x_4y_3 - x_3y_4\}$.

In a similar manner the area of any polygon may be found.

Exercise 2

(1) Find the area of the triangles whose angular points are :

(*a*) (2, 1), (3, -2), (-4, -1);

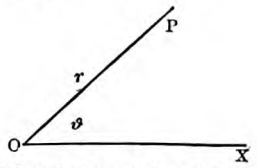
(*b*) (4, -5), (5, -6), (3, 1);

(*c*) (2, 3), (4, -5), (-3, -6).

(2) Find the area of the quadrilateral (2, 2), (-2, 3), (-3, -3), (1, -2).

7. Polar Co-ordinates.

Another method of defining the position of a point is often used.



Take a fixed point O and a fixed straight line O X. Then if P be a point, if the distance O P be given, and the angle X O P which O P makes with O X be also given, the position of the point P is determined.

These are called the **polar co-ordinates** of the point P.

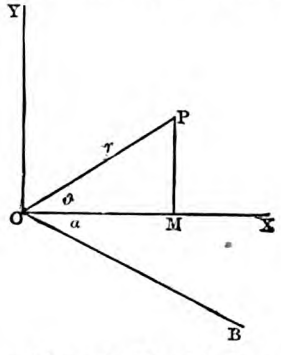
O P is called the **radius vector**; the fixed point O is called the **pole**.

The length O P is usually denoted by r and the angle X O P by θ.

θ is considered positive if measured by a counter-clockwise rotation.

r is considered positive if measured from O to P.

8. *To change from rectangular to polar co-ordinates.*

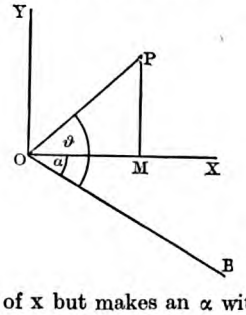


Let the fixed line coincide with the axis of x.

Then $x = \text{O M} = \text{O P} \cos \text{X O P} = r \cos \theta$

and $y = \text{M P} = \text{O P} \sin \text{X O P} = r \sin \theta$.

Next suppose the fixed line O B does not coincide



with the axis of X but makes an α with it. Then angle $\text{X O P} = \theta - \alpha$ and hence

$$x = r \cos(\theta - \alpha)$$
$$y = r \sin(\theta - \alpha).$$

9. *To express the distance between two points whose polar co-ordinates are given.*

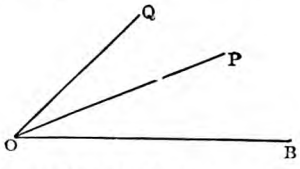
Let the points be P and Q.

Let the polar co-ordinates of P be $= r_1, \theta_1$.

Let the polar co-ordinates of Q be $= r_2, \theta_2$.

i.e. $\text{O P} = r_1$; $\text{B O P} = \theta_1$; $\text{O Q} = r_2$; $\text{B O Q} = \theta_2$

$\text{P O Q} = \theta_2 - \theta_1$.



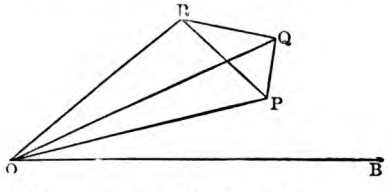
Now $\text{P Q}^2 = \text{O P}^2 + \text{O Q}^2 - 2\,\text{O P} \cdot \text{O Q} \cdot \cos \text{P O Q}$

$= r_1^2 + r_2^2 - 2 r_1 r_2 \cos(\theta_2 - \theta_1)$

hence if the distance $\text{P Q} = d$,

$$d = \sqrt{r_1^2 + r_2^2 - 2 r_1 r_2 \cos(\theta_2 - \theta_1)}.$$

10. *To find the area of a triangle, having given the polar co-ordinates of its angular points.*



Let P have the co-ordinates r_1, θ_1.

Let Q have the co-ordinates r_2, θ_2.

Let R have the co-ordinates r_3, θ_3.

Area of $\triangle \text{P Q R} = \triangle \text{P O Q} + \triangle \text{Q O R} - \triangle \text{P O R}$

$\triangle \text{P O Q} = \frac{1}{2}\,\text{O P} \cdot \text{O Q} \cdot \sin \text{P O Q}$

$= \frac{1}{2} r_1 r_2 \cdot \sin(\theta_2 - \theta_1)$

$\triangle \text{Q O R} = \frac{1}{2} r_2 r_3 \cdot \sin(\theta_3 - \theta_2)$

$\triangle \text{P O R} = \frac{1}{2} r_3 r_1 \cdot \sin(\theta_3 - \theta_1)$

$= -\frac{1}{2} r_3 r_1 \sin(\theta_1 - \theta_3)$.

$$\therefore \triangle \text{P Q R} = \tfrac{1}{2}\{r_1 r_2 \sin(\theta_2 - \theta_1) + r_2 r_3 \sin(\theta_3 - \theta_2) + r_3 r_1 \sin(\theta_1 - \theta_3)\}.$$

Examples :—

(1) What are the rectangular co-ordinates of the point whose polar co-ordinates are $2, \frac{\pi}{3}$?

$$x = r \cos\theta = 2 \cos\frac{\pi}{3} = 2 \times \tfrac{1}{2} = 1$$

$$y = r \sin\theta = 2 \times \sin\frac{\pi}{3} = 2 \times \frac{\sqrt{3}}{2} = \sqrt{3}.$$

(2) Change to polar co-ordinates the equation in rectangular co-ordinates $x^2 + y^2 = mx$

$x^2 + y^2 = mx$

$\therefore r^2 \cos^2\theta + r^2 \sin^2\theta = m r \cos\theta$

$\therefore r = m \cos\theta$.

(3) Change to rectangular co-ordinates the equation in polar co-ordinates $r^2 = m \cos 2\theta$.

$r^2 = m \cos 2\theta$

$$r^2 = m(\cos^2\theta - \sin^2\theta) = \frac{m}{r^2}(x^2 - y^2)$$

$\therefore r^4 = m(x^2 - y^2)$

$\therefore (\cos^2\theta + \sin^2\theta)^2 r^4 = m(x^2 - y^2)$

$\therefore (x^2 + y^2)^2 = m(x^2 - y^2)$.

Exercise 3

(1) Change to rectangular co-ordinates the polar co-ordinates.

$\left(1, \frac{\pi}{2}\right)$, $\left(2, \frac{\pi}{6}\right)$ and $\left(6, -\frac{\pi}{4}\right)$.

(2) Change to polar co-ordinates the rectangular co-ordinates (1, − 1), (3, − 4). M. A. L.

Continued from page 360.

ART AND MUSIC:

Contributors:—THE THEORY OF ART (Hon. John Collier; J. G. B. Lynch). DRAWING AND PAINTING (J. G. B. Lynch). THE THEORY OF MUSIC (R. R. Terry, Mus.Doc., F.R.C.O.; Hubert Grant).

SKETCHING FROM NATURE.—I

SKETCHING from Nature is a delightful pastime, and so far as it goes is a complete art in itself. You will very likely wish to make water-colour drawings, such as we have been discussing in the last few lessons, but admirable work may be done simply with a pencil, both of wide landscapes and of out-of-door objects.

Do not take the word *sketch* to imply slipshod work. It has come to mean that in some senses, but here it should be regarded merely as an alternative expression to *drawing*.

It may happen now and again in the following lessons, that you will be referred back to the lessons in drawing which began this series. But all unnecessary repetition will be avoided. In the main it must be taken for granted that you have your lessons in drawing from the flat thoroughly in your mind.

Materials and Implements

In drawing from Nature you have an absolutely indefinite variety of subjects, even when your station point is on the same spot. A tree, morning and evening, forms totally different things. Almost every hour of a summer's day, for that matter, makes a difference in the same tree, or shrub, or patch of heather, from the artist's point of view.

We now turn to the question of materials and implements. These are neither many nor complicated. In the first place you need a block of drawing paper. These have already been described. They consist of several sheets bound together at the edges in such a way that they can be torn off one by one as required, by the simple introduction of a penknife beneath the edge of the uppermost. Once you have finished your drawing, you rip it off and a clean sheet comes to view beneath it.

The kind of paper depends partly on your own taste. But it is better to have a fairly smooth surface. Detail is exceedingly difficult to render when the paper is very rough. The roughest sorts of paper are best kept for colours. Take only three pencils—a B, an HB and an H. Thus you will be fully equipped. Remember, however, to carry with your block a piece of *clean* spare paper to put over any part of the drawing, so as to protect it from smudging by your hand.

Choice of Subject

You may find it rather hard to realise, at first, how entirely different sketching from Nature is to drawing from the flat or object. Once you have made the plunge with your first attempt, however, you will see wherein the many and great differences lie. In the first place, when you are drawing from the flat, that is to say, from another picture, every object is reduced in size; inessential details are left out. You only see before you what you intend to draw.

Another and much more important difference is the general effect of what you are drawing. The outline in the picture can be copied exactly. But in Nature there is not half so much strict outline. There are only *masses* which are differentiated, firstly by light and shade, and secondly by colour. Whilst in the picture each object is placed in perspective upon *one* surface, so that you only have to copy and not think of advancing or receding lines, in Nature, everything is at a different distance from the point where you are sitting.

This brings us to the difficult questions not only of lineal, but of aerial, perspective. So, taking the subject from at least one viewpoint, sketching from Nature is far more difficult and arduous than drawing from the flat.

We now come to the beginner's first choice of an out-of-door subject. Don't

be too ambitious at the outset. It will be a great temptation to choose a wide landscape, hills, rivers, and a great spreading of trees and bushes. But do not give way to it. So many people make this mistake. They think only of the beauty of the scene before them. It never occurs to them that the composition must be studied, and a thousand and one things with which the beginner in sketching is quite unfamiliar.

A story is told of a Royal Academy student who copied a landscape by an old master. This was an elaborate picture, and the student succeeded well in his rendering of it. He knew he had done well, better indeed than he believed at the outset he could do. So he immediately determined to do something of his own, an original picture from Nature. Accordingly, he went to the top of a high hill and proceeded to begin his picture of the wide view which extended from his feet.

He worked at this with the best intentions for many days, but found that he could get no "forrader." As fast as he painted in one object he found that he had to paint out another. Finally he gave it up thoroughly disheartened. The frequent changes of light and shade puzzled and perplexed him.

This student took what he had done, however, to show to Constable. The great man gave him the following advice:

"My young friend, go and draw a gate post, and when you have done that draw two posts, and go on till you can manage a dozen: afterwards add a cottage, and then a tree, and proceed in this way until you have power to do something more elaborate before you think of painting such a subject as this. You have made precisely the same mistake that I made when I was your age; you have begun at the wrong end."

This advice of Constable sums up the question very well. It is the greatest possible mistake to embark on a complicated undertaking, made up of innumerable side issues, before those side issues have been the subject of separate careful study. In a sense, you have to begin all over again when you come to sketching from Nature, but only in a sense.

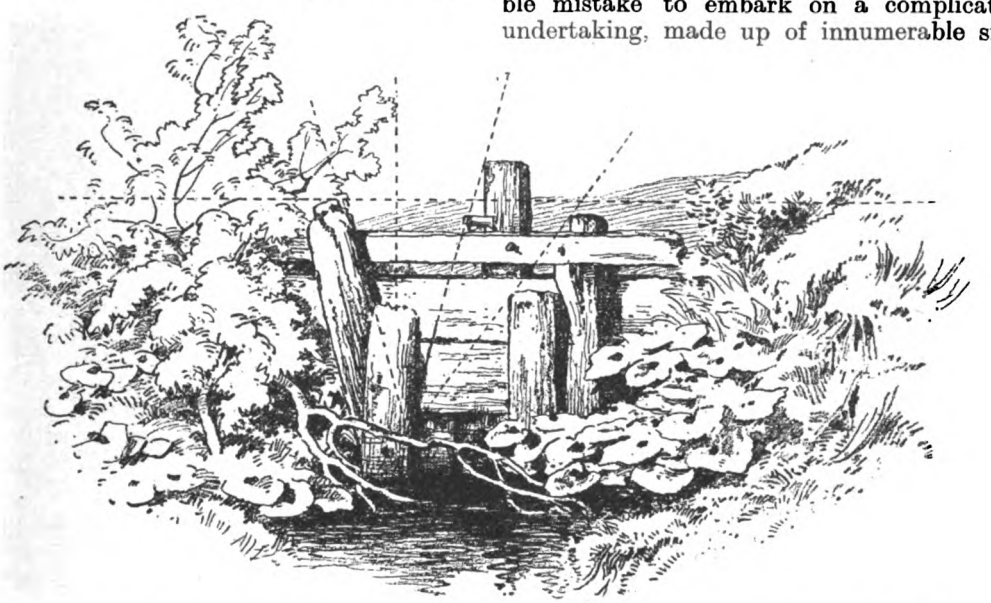


Fig. 91.—To the student making his first essay in sketching from Nature, a small bridge, or stile, or some such object as is shown above, is quite sufficiently ambitious.

This is not meant as discouragement. Nature study is a fresh development of art, but the lessons you have learnt and the practice to which you have submitted yourself in drawing from the flat make your Nature work sure and certain.

If you strictly obey all the old rules and take trouble, go slow, and do not grudge time, you will soon become accustomed to drawing from Nature.

Of course, it is much wiser to choose as simple a subject as possible for the first attempt. Take Fig. 91. This is a good example of the kind of sketch to begin on. Don't copy this illustration from the reproduction here, but seek out some similar object when you are looking for a suitable beginning. The rules for drawing this particular

object will, however, bear on many other subjects and will repay careful study.

In the first place you must draw a good outline with a few shadows marked in with parallel lines here and there. Notice particularly that you must shade the post on the left so as to throw up the branch that crosses it into relief. There are no retiring lines in this object, so you do not need to mark your vanishing points.

These and other questions of perspective we can leave till a little later. A good distance from such an object as this to the station point, that is the place from which you observe and do your drawing, is a dozen yards or so. At that distance everything you require to observe for the drawing is well within an angle of sixty degrees.

Any object of this sort will do for your first essay: a stile or a small bridge; and these can readily be found. It is a good plan to persevere with outline pure and simple for a time until you have grown quite used to the true rendering of outline copied from Nature. Shadow you must use from the beginning, but it is unnecessary except to assist the outline as in the case of the branch instanced up above.

Importance of Outline

Remember that the outline is the most important point of all, and needs the most diligent practice. If you go in for careful shading throughout your picture from the start, you will frequently be spending time and trouble on shading a poor and weak outline, and that is waste of energy.

You should allow yourself a certain amount of system in Nature drawing. Sit down on your sketching stool and observe carefully and for some minutes what you are going to do before you begin to do it. First of all, you have to make up your mind *how many* objects you are intending to draw. Having made up your mind about that, you must next fix in your mind's eye the *middle* of the object; for this must come in the middle of your drawing. You must not only fix this middle laterally, that is to say, from left to right and right to left, but vertically as well, so that you have a certain amount of sky above your drawing and a certain amount of foreground at the bottom of the picture.

As a matter of fact, with practice, the artist comes to find the middle of his object instinctively without thinking of it in definite terms.

Then you must attend very closely indeed to your subject, and concentrate your whole mind upon it. You must sum up what separate objects go to make the whole, and most particular attention should be paid to the relative positions of one object to another. These are all things which *precede* the laying of your pencil on the paper. You have to think, firstly, of form, that is to say, the character of the whole subject; then, secondly, of the position of one separate part as regards its next-door neighbour and the composition of the whole from the many separate parts.

Right Proportions

In this way you become thoroughly used to, and familiar with, your object before you begin to draw it. That is imperatively necessary. You must also learn to test the height of each object in turn. You can do this by holding your pencil horizontally before your eyes. Let the edge of the pencil appear to touch just the top of any one object. Then by carrying the eye along the pencil you will see what other objects are of the same height and compare them with others of different heights. The dotted lines in Fig. 91 show the various directions in which the pencil might be held between the eye and the object and the result it gives in deciding how the parts are placed in connexion with each other.

J. G. B. L.

MUSIC.—XI

In the years that have passed since the invention of the first piano-key mechanism, ingenious people have occupied themselves with improving and endeavouring to perfect the means for striking the wires. The object sought has been to get a clean, clear blow from the hammer, minutely responsive to the pressure put on the key; to allow the blow to be repeated with all the rapidity of which the most nimble finger is capable; and to control the duration of the sound by checking or prolonging at will the vibrations of the wires.

Many aids to the attainment of this much-sought perfection have been developed. The lever-control of the hammer is a thing of wonder and beauty; the sounding-board and other resonant parts of the piano are fashioned and constructed in accordance with acoustic principles; iron frames permit the tension of heavy bass wires and trichord stringing; and the assistance of the pedals, even in cheap instruments, in obtaining softness and additional loudness of sound, or in sustaining the tone, has reached a high degree of efficiency.

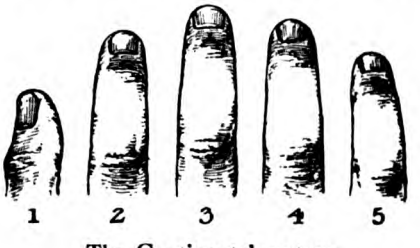
Nothing could be better for anyone desirous of understanding the principles of the mechanical side of piano-playing than to remove the front of the instrument and to observe very carefully the action of the mechanism set in motion by the key. Incidentally the bed of the pianoforte can then be brushed or dusted.

It is remarkable how few people attend to this really necessary act, for the amount of dust which congregates under the keys of a piano that has been a little time in use is extraordinary.

An hour or two spent in thoroughly grasping the interesting character of the movements set up by the blow of the finger on the piano key, and so being able to retain a permanent mental impression of what is taking place "behind the front," will do a great deal towards shortening the period of preliminary exercises.

Essentially, these exercises consist in efforts to obtain perfect control over the five fingers (of both hands).

For the purpose of showing what finger is



The Continental system.

to be employed in playing any note of an exercise, or note in any other musical piece, two systems of finger-marking are in use.

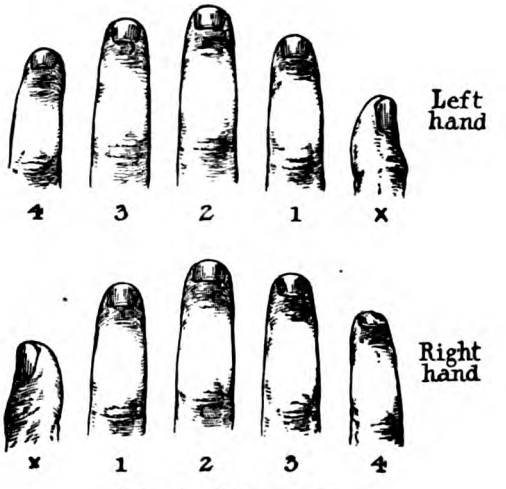
Germans, Italians, French, and other Continentals use the figures 1, 2, 3, 4, 5 for the thumb and four fingers of each hand, as shown above.

This order is known as the Continental system. The other system is called the "English" system. In this, the "thumb" note is marked by a small x, and the four fingers are marked 1, 2, 3, 4, as shown in the above diagrams.

The reason for the difference between Continental and English usage is a little obscure. It may have had its origin with rival music publishers, as has been suggested; or it may have been due to the efforts of Continental teachers who first developed the higher technique of the harpsichord and clavichord, and taught the modern use of the thumb, the free employment of which had for centuries been tabooed. English musicians, conservative of old customs, retained the finger-notation 1, 2, 3, 4, and added an x for the thumb. This system will suit our present purpose best.

It is a regrettable fact that the human hand, generally, suffers from an anatomical defect which restrains the freedom of movement of the third finger; and it is a task of some difficulty with most students of the piano to get this finger to do the work required of it.

Press fingers 1 and 3 lightly on the table, and move 2 upwards. Observe the freedom with which you can move it to a consider-



The English system.

able height. Now try 2 and 4 on the table, and raise No. 3. The beginner, and probably also some who have made progress in playing, will find that this finger is, as it were, tied down. Yet good technique is only possible when this finger has equal strength and elasticity with the others.

In the young this restricted freedom of movement of No. 3 finger can by patient effort mostly be overcome. Later in life it cannot be easily conquered. Persons of adult age who become piano students—mainly because they do not follow the right plan—fail to acquire so good a technique as those who begin practice in early years. But that fact should deter no one from the trial.

Whilst the outside of the hand is invariably weaker than the thumb side, and the third finger mostly weakest of all, some students find a particular difficulty with the thumb, and others with the touch of the

first finger of the right hand, which, owing to movements demanded from it in certain occupations, has a tendency to stiffen.

The "shaping of the hand," the easy droop of the fingers at their first joints, the position of the wrists, and the general elegance of the pose at the piano, should all be carefully considered by the student. "Relaxity," the perfect freedom from any sense of restraint or awkwardness, is the feeling to be sought. Perfect control over the means of doing a thing secures that it will be well and gracefully done.

With regard to the blow upon the key. It is necessary for the student to observe very carefully the quality or nature of the tone produced by the blow of the finger or thumb. Some are lucky enough in the shape of their hands and fingers, and in natural poise, to produce a good tone, seemingly, without having ever troubled about it. Others have to work and practise, sometimes laboriously, and for a long time.

For all who are beginning to practise, the study of the *release of the key*, i.e., the lifting of the finger from the ivory, is of as much importance as the blow.

For those endeavouring to cure a bad tone-production, it is the *one thing which will help them* in their effort.

Legato playing—the smooth, warm playing, where the sounds are alive, firm, and distinct, and do not run off with ragged edges, or are consumptively short of breath—is produced by the neatness and skill with which one key is held down till the blow on the next is struck, and is then released by a quick, upward movement of the finger.

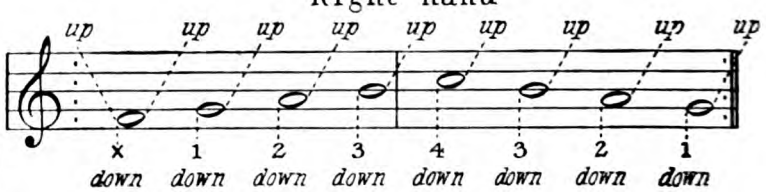
A sort of piano with a dumb keyboard —the keys of which produce only a "click" —has been some years in use by certain schools and some private teachers to enable their pupils to acquire the right touch. A mechanism is so arranged that unless the keys are struck and released properly, there is no "click."

The notion has great merits, and may be depended upon to receive the flattering testimonials of neighbours, who are relieved from the monotonous sounds of the practice hours.

It has been pointed out, however, by one of the most famous of pianists that a student loses rhythm and control of force unless the touch on the keys is associated in practice with the proper sounds. The secret of the "touch," however, is the "click"; and the proper place to learn it is the pianoforte keyboard.

Let us clearly grasp the idea. It is contained in the following exercise:—

Right hand

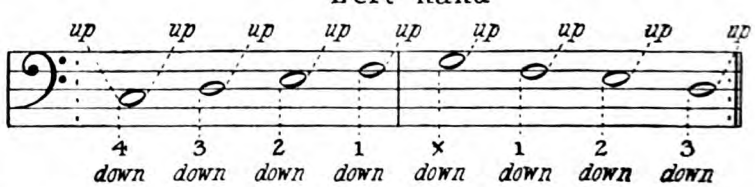


Strike F with the thumb firmly (*down*), and keep your thumb down; then give the blow on G with the first finger, saying (mentally) "Down" as you make the downward movement of the finger.

As soon as you have "played this stroke through," as we say at cricket, lift up the thumb sharply as you mentally say "Up."

Now strike A with the second finger, saying "Down," and lift No. 1 as you say "Up." Do this with the eight notes of the exercise, slowly and carefully, a good many times; but do not tire your hand, nor keep at it till your attention wanders.

Left hand

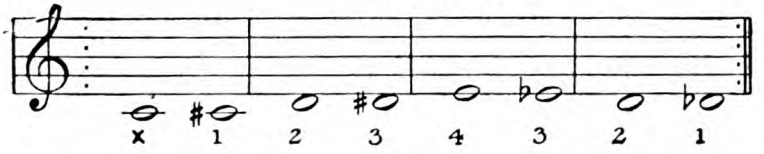


The points to be particularly noted in playing this exercise are that the blow on the key should be made with the bent or curved tip of the finger or thumb, that "Up" should be mentally said immediately *after* the "Down" has been played on the next key, and that the lifting of the thumb and fingers—note specially Nos. **3** and **4**—should be quick, clean, and high.

Practise this exercise through every note of the octave—the white keys. It gives variety, and there are slight differences in the "feel" of the keys as to position.

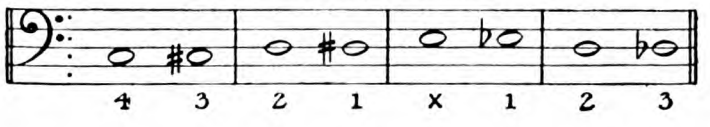
When you feel that you have got command over your hand as regards the white keys, you may proceed to the notes of the chromatic scale :—

Right hand



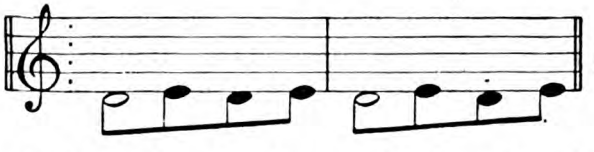
Play this exercise in exactly the same way as the previous one. Its object is to accustom the sensitive fingers to adapt themselves automatically to the differing heights of the black and the white keys. It is likely to be found a little awkward at first—for some more than others—but you will have a great sense of freedom and certainty as the result of a few minutes' practice per day—starting, in turn, from *each of the twelve notes of the scale*—carried on for even only a couple of weeks.

Left hand



Play exercises slowly, starting on each succeeding note in turn, with the right hand.

For a change, a slow trill on each note may be played, with right or left hand alternately :—



&c.

Take each note of the diatonic and chromatic scales in turn with the thumb and each of the fingers, playing the notes exactly in the same way as the original five-finger passage; saying, mentally, "Down," and "Up," and closely observing that the sound of the notes as they, as it were, *rub against each other*, is right. This will be equivalent to the "click" on a dumb clavier.

Play slowly, and make no "waggly," false movements of thumbs or fingers.

It is possible, as we have before said, that you may find these exercises a little tiresome at first; but if you are really in earnest, the use and advantage of the practice will quickly be apparent, and the feeling of elasticity and certainty that will be acquired in your fingers will amply repay all trouble.

Keep your eyes on the keys and on your fingers. Try to preserve a graceful movement of your hands, and *think* of what you are doing, and nothing else. If your attention wanders, you are losing time.

The "shaping" of the hand means training it to observe that position over the keyboard which will enable necessary movements to be made with the utmost ease and celerity of which the individual student is capable. Complete command of the thumb is essential to this.

For those who have to be their own schoolmasters, and who desire to "school" themselves, there are two principal things to aim at. They will have been recognised by now, viz. :—

(1) To train the thumbs to go under the hand automatically and easily. This makes for grace and adroit playing.

(2) To strengthen the outside of the hands. This brings evenness in playing. It assures a firm, clear bass note, to mark the rhythm and the decision, but controlled accentuation of the melody notes, particularly in chordal passages, where clearness depends entirely upon the third and fourth fingers of the right hand.

On page 494 are two exercises designed to encompass both purposes.

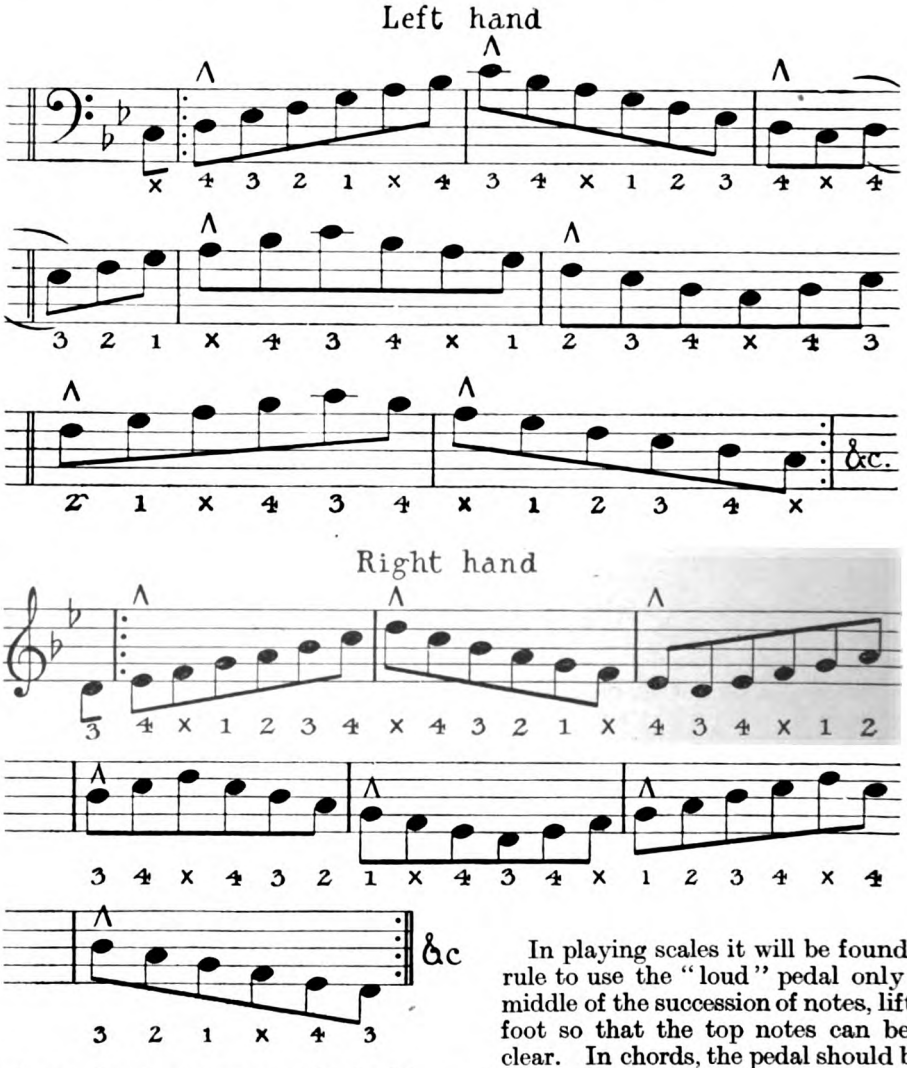
These exercises should be played every day, at least twelve times each, *slowly*, and in the same manner as the legato exercise. The notes may be grouped differently—played in fours—by way of change to the hand.

But the main purpose of the exercise is to gain ease of movement for the thumbs, and to strengthen the third and fourth fingers. In regard to the thumb, the effort should be made to "think forward"; that is to say, as the fingers fall on the keys the thumb must be pushed forward so as to be ready to strike without the least hesitancy.

When you have mastered your thumbs and have obtained a sure blow from the third and fourth fingers, play scales from one end of the piano to the other, carefully, distinctly, and *slowly*, in every key—thumbs on C and F in flat keys, except in G♭, when the thumb falls on the white note B, which becomes C♭ in this scale. In sharp keys the thumb falls as in the key of C.

Little less importance in good piano-playing than belongs to the hands and their correct touch and poise attaches to the use of the feet.

The proper use of the pedals, however—and particularly of the "sustaining," or "loud," pedal, as it is commonly called—belongs to a more advanced period of study than is covered by this course.



Also play scales in octaves, with double, treble, or quadruple blows to each note.

Lift the hands quickly and cleanly from the keys, with plenty of movement, or fling, of the wrists. Wrist-work, finger-freedom, and loose shoulders are the foundations of technique.

When some facility in scale-playing and octaves has been acquired, pass on to arpeggios.

In playing scales it will be found a good rule to use the "loud" pedal only in the middle of the succession of notes, lifting the foot so that the top notes can be struck clear. In chords, the pedal should be lifted with the changes of harmony, and the foot should press the pedal immediately *after* the chord is struck. In fact, the process should be a sort of reversal of that involved in fingering.

The idea in pedalling is to get a sustained or a fuller tone, but also to prevent the mixing of discordant sounds. The "soft" pedal gives the subdued or muffled tone required in *pianissimo* passages. H. G.

Continued from page 368.

BUSINESS AND COMMERCE:

Contributors:—BOOK-KEEPING (Frederick Heelis, F.C.I.S.). SHORTHAND (by arrangement with Pitman's Schools). COMMERCIAL TRAINING (Arthur Brooke). CHOOSING A CAREER (A. C. Marshall).

COMMERCIAL TRAINING
XXXV

FACE value or " par " value, represents the worth of shares at their time of issue and directly such shares are placed upon the market their buying and selling price fluctuates according to the profits paid, the commercial outlook of the company, the reflection from stocks and shares of a similar type, the bank rate of the day, and so forth.

Summing this up, the worth of stocks and shares depends upon the supply and demand, in precisely the same way as these matters affect everything else that may be bought and sold. Thus, with a company in a state of affluence and prosperity, it is reasonable to assume that people holding shares should wish to retain them so that they may benefit to the utmost from their investment, with the direct result that few shares will be placed on the market and consequently the demand will exceed the supply to such an extent that the price will rise.

On the other hand, with a company showing declining returns we may imagine shareholders wishing to withdraw their investments so that the money might be placed in a more remunerative concern ; a state of affairs that might lead to the market being flooded with the particular shares, thus ensuring an inevitable slump and drop in price, for the supply would exceed the demand.

Investment and Speculation

Broadly speaking, a person places money in stocks and shares for one of two main purposes—as an investment or as a speculation. An investment is the purchasing of stocks and shares of proven stability and undoubted prospects as a means of locking-up money at a safe rate of interest. Speculation is usually a far quicker process, the idea being to buy shares for a rapid rise and then to sell hurriedly should the increase not materialise.

The safest and wisest stocks and shares in which to invest money are those known as " gilt-edged " securities. Most of the British Funds and certain others are known as " trustee stocks " ; that is, people acting as trustees for the estates and property of others, as so frequently happens under wills, are empowered by law to invest the trust money in these particularised stocks.

Trustee Securities

Trustee stocks, broadly, embrace the following securities : Public Funds and Government securities of the United Kingdom ; Bank of England and Bank of Ireland Stock ; India Stock ; any securities the interest on which is guaranteed by Parliament ; preference, guaranteed and debenture stock of any home railway company which has paid during each of the preceding ten years a dividend of not less than 3 per cent. upon its ordinary stock ; stock issues by a corporation or other municipality with a population exceeding 50,000, and any stock or securities in which cash under the control of the High Court may be invested.

From the point of view of the investor, the shares offering security and return next in value to the trustee stocks are those of sound, industrial ventures, particularly the cumulative preference shares. Such shares do not possess quite the security of a Trustee stock, but the margin of risk is compensated by the increased return.

Bank shares—which are usually only partly paid—rank very much with industrials for the purposes of investment. Then there are colonial and foreign railways, American railways, and a variety of other securities, all of which may be said to be available for investment ; with greater or lesser guarantee of stability, according to the circumstances of the individual company or undertaking.

Beyond this point it may be said that we enter the realms of speculation with a

trebled prospect of earning interest and profit but with a more or less diminishing security. Rubber shares, oils, diamond mines, copper mines, gold mines, and so on are available for speculative investment and, precisely as is the case with the safer stocks and shares, so in this market too it is purely a question of supply and demand; though the fluctuations of prices are far more marked, this particular market being liable to rise or fall on the flimsiest suggestion of changing profit or loss.

The buying of stocks and shares and the sale of securities is usually undertaken through a broker, who is a member of the Stock Exchange. The principal Stock Exchange in this country is situated in Throgmorton Street (main entrance) in the City of London. It is not a government department, but is conducted by a joint stock company in which members are shareholders. In many large provincial cities there are also Stock Exchanges.

It is upon 'Change that the actual buying and selling prices of securities are fixed; and a new company before it may have its stocks and shares quoted in the official list of prices current must conform to the regulations of the Exchange. At the close of each day's business the Exchange issues its list of prices and these are taken throughout the country as being the official and actual commercial worth of the particular shares specified.

Jobber and Broker

The members themselves are divided into two classes, jobbers and brokers. Inside the House itself the jobbers are so divided that they form groups, each group representing a particular market — the gilt-edged market, home railways, industrials, mines, rubbers, oils and what not. The jobber specialises in his own particular market.

It is the broker who comes into contact with the general public. He receives an order say for £100 worth of stock in a home railway from a client. Entering the House he approaches the jobbers who deal in the Home Rails market and from one of them purely by verbal expression purchases the stock. The broker, it will be seen, acts as a middleman or intermediary between the public and the jobber.

Having purchased the stock or shares from a jobber, the next step is for the broker to forward to his client a Contract Note and upon this document is stated the exact price of purchase, the stamp duty and also the broker's commission. The same method of procedure would be followed by a broker in the case of sales of shares.

The transfer of any stocks and shares (except those in the nature of Inscribed stock or bearer bonds) is arranged by the execution of a transfer deed. Upon this document the buyer is termed the transferee and the seller, the transferor. Though the buying and selling of shares and stocks is usually in the hands of members of a stock exchange, there is nothing to prevent two individuals doing business with one another without a broker, and they may fill up the transfer form in the ordinary way. At the base of the form are placed the signatures of the seller and buyer, together with their seals—in these days usually a little disc of red gummed paper. Each signature is also witnessed by a person who is called upon to furnish his or her address and occupation.

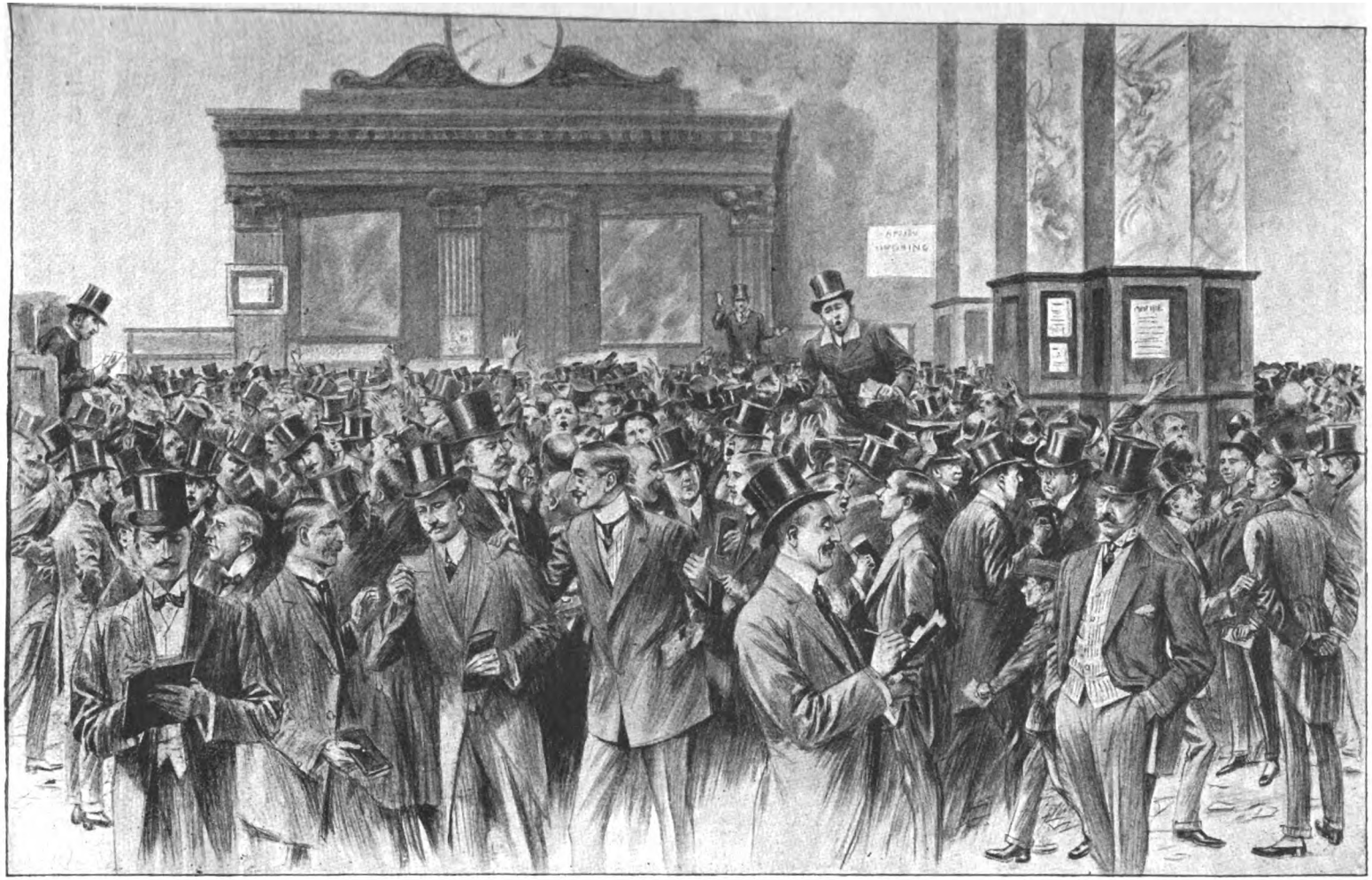
Transfer Formalities

Then, in exchange for this transfer deed and for the company's official certificate concerning these shares, the buyer pays to the broker of the seller the amount agreed upon.

The transfer deed is next lodged with the company, whose shares it represents at the office of that company, together with the transfer fee, which in most cases is half a crown. The company then sends a formal, safeguarding note to the seller, acquainting him with the fact that a transfer deed has been lodged with them; and, should everything be in order and no objection be received from the seller—this latter formality is entirely in his interests, designed to prevent fraud—a new certificate is prepared for the shares, the requisite alteration made in the company's books, and at the next Board Meeting of the company the certificate is signed by certain directors and the secretary and sealed with the company's common seal. A day or two later, this new certificate is posted to the buyer and the transaction may be regarded as complete.

So far no mention has been made of the cost of buying and selling stocks and shares. So far as the jobber is concerned, he depends for his living upon the turn of the market; that is to say, upon the margin between the official buying price and the figure fixed for selling. Brokers are entitled to make to their clients a charge for commission upon the transactions they carry through, reckoned on the value of the stocks and shares dealt in.

A. B.



Drawn by S. Begg, from a sketch by a Member of the Stock Exchange.

THE STOCK EXCHANGE DURING A "BOOM" IN RUBBER SHARES

which during recent years have proved the most unstable and tempting commodity dealt with in the financial market. Rubber, it is interesting to note, first came into use in this country early in the nineteenth century, at about the time when the Stock Exchange was established.

CHOOSING A CAREER.—XL

Builders. — There are naturally many branches in this calling, which has the advantage of being a stable one. In some parts it is customary for a lad to be apprenticed to a builder and when this occurs with a firm of standing the premium is large.

It is necessary for a builder to be a thoroughly practical man in every branch of his calling. He must be able to take an architect's plan and to work out from it the prime cost of the materials and labour required to erect the building specified. He must understand drainage systems, the strains of steel, masonry, brickwork and so on; and, if necessary, be able to draw a rough plan himself. All these matters are taught in our technical schools.

Butchers.—The old system of apprenticeship in the butchering business is almost entirely in abeyance. At the present time a lad accepts a post as butcher's boy and for the first few years assists in the cleaning of the shop, the delivering of meat and similar matters. His next step will probably be to the position of roundsman or junior salesman, and, from that, he may become a salesman or the manager of a branch.

Buyers. — With large business firms, drapers and Manchester warehousemen in particular, the position of buyer is of the utmost importance. In some lines there are lady buyers and with most businesses buyers have to travel to the headquarters of the particular commodity they deal in. The buyer is in fact the counterpart of the commercial traveller.

It usually happens that buyers are promoted from the subordinate staff of the firm by which they are employed; and among big firms in one line of business there is keen competition to obtain the services of expert buyers so that these workers are often paid from £800 to £1,000 a year.

Cabinet Makers.—So far as London is concerned, there are innumerable cabinet makers who carry on their work in small workrooms attached to their own homes. In the provinces, however, it is customary for the worker to be employed in a factory devoted entirely to the production of furniture.

Under both systems, however, boys may begin as apprentices, earning small wages during this period, according to the district and conditions. Journeymen cabinet makers are sometimes paid by the hour and frequently by the piece. In most towns there are technical classes at the continuation schools; and, beyond the cabinet making stage, there is work for skilful designers of furniture and fittings.

Cabmen.—To become the driver of a taximeter cab it is necessary that the applicant shall be a careful and capable driver of motors, competent to make small running repairs and well acquainted with the roads over which he is likely to drive. He must possess the ordinary licence to drive a motor, and in the cities a taxi-driver's licence as well. In London he has to pass a police test at New Scotland Yard, and no one may ply for hire in the metropolis without the official badge or certificate.

Carpenters and Joiners. — In some parts the old system of apprenticeship for four years still prevails; but, generally speaking, a boy enters the workshop as a learner. After three or four years he will become an improver and eventually will be able to undertake work as a journeyman carpenter.

Few trades offer more inducements to the lad who is willing to study his subject thoroughly, for carpenters who possess a sound knowledge of the different woods, of fancy work and of the more important tasks of their calling may always be certain of good employment, whilst there is a perpetual demand for the services of qualified carpenters in our overseas dominions.

China Painters.—Many people with decorative ability, and women in particular, find employment in the painting of china of the more valuable kinds. They must not be confused with pottery workers. The opening is naturally a limited one, but those desiring to paint cups and saucers, vases and plaques should submit specimens of their decorative colour designs to firms of china manufacturers, whose addresses are to be found in a trade directory at a free library.

Clerks.—The principal qualifications to general clerkship are the ability to write quickly and well, to keep books, compose letters and such matters. Both shorthand and typewriting are often essential and in some cases a complete knowledge of bookkeeping is required.

There is no calling in which self-education may lead further than in clerking. The young clerk who will devote some part of his leisure to learning commercial geography, languages, business theory and similar advanced subjects will be certain to prosper

To become a clerk it is usually the custom to start as an office boy or junior, learning to manage the telephone, to copy letters, run errands, and to perform similar duties.

Such positions are freely advertised in the newspapers.

Clock-making.—In the majority of instances the parts for the making of clocks are stamped out by machinery and assembled by means of clever mechanism; and the bulk of our clock-making industry has been lost to foreign countries. At the same time, there still remains in Coventry an important business in the making of better class clocks, particularly large ones, and those who would wish to enter this calling should get into touch with some of the Coventry firms.

Clothiers.—There is usually a very good opening for retail clothiers in industrial districts. It goes without saying that the proprietor of such a business should have had a good deal of experience as an assistant in the tailoring or clothing trades; and the system is to make a show of the latest styles in ready-made clothes in the window and so to obtain orders. These orders are then dispatched to a firm of wholesale clothiers to be made up from the measurements taken of the customer.

First-class cutters are employed at the wholesale houses, and when measurements are accurately taken a perfectly fitting garment is assured. Ranges of patterns are provided and the profit to be earned on this business is in the neighbourhood of 30 per cent. Many tradesmen combine hosiery and outfitting with this class of business.

Coal Merchants.—There are at least two ways of becoming a coal merchant. A clerk or canvasser in the employ of a coal company may by careful saving or otherwise control sufficient capital to start in business for himself. On the other hand, a roundsman may in time with perseverance save sufficient to purchase a horse and dray, scales and other appliances, and so commence a small retail house-to-house round that may eventually develop into a large business.

The retail coal merchant purchases his coal from a local wholesale dealer or direct from the colliery. Contracts are invariably made for a considerable time ahead.

Commercial Travellers.—The ambassadors of commerce, those men and women who travel the country representing their firms to the retailer are entirely recruited from the office and warehouse staff, and no one may hope to get on the road without having spent from three to ten years in becoming thoroughly acquainted with every aspect of the particular trade. It is possible for a youth to enter the counting house as a clerk or to join the warehouse staff and the same remark applies to girls, in both cases with a view to becoming commercial travellers.

Given the complete working knowledge of the trade, success on the road is dependent upon a smart business-like appearance, good address, promptness in keeping appointments and tact. The majority of commercial travellers receive a standing salary, a liberal commission on orders booked and a fixed allowance of so much per diem for expenses.

Compositors.—A most important and highly educated class is that formed by the working compositor. His duty is to set in type matter to be printed; and, whereas advertisement and other display matter is invariably set by hand (together with headings, footlines, and such classes of printing), the more solid parts of a newspaper, magazine or periodical are set up on the linotype or monotype composing machine.

To become a compositor it is necessary for a boy to be apprenticed and the period is usually seven years. At our technical schools there are special classes for printers and compositors; and this trade opens up a big field for the self-educated worker.

Cooks, Female.—To the woman who will devote a considerable amount of her time to acquiring a thorough knowledge of the practical and theoretical sides of cookery there are unlimited openings. At large houses it is the custom to engage educated women as lady-cooks and as cook housekeepers at wages of from £50 to £80 a year, with separate living apartments.

In the smaller good class hotels women cooks are also largely employed to direct the culinary work; and many clever cooks are found in partnership with good business women conducting tea-rooms, restaurants, boarding-houses, and so on.

Cooks, Male.—Men cooks are employed at sea, in large schools and institutions, on our railway systems, in H.M.Prisons and in a variety of other places. They are also engaged in hotels under the more dignified title of chefs. To become a cook a man should commence as a boy and should seek to acquire theoretical knowledge at a technical school.

Corn Dealers.—The increase of mechanical traction has to a great extent altered the business of the corn factor and forage merchant, but there are still good openings in the trade. There is much to be learned, the value and uses of all the cereals, the comparisons between those grown abroad and those produced at home, the feeding

values of the different grains, the cost and uses of the heterogeneous collection of patent foodstuffs for poultry, pigeons, rabbits, cage birds and other livestock. In connection with most of these businesses a gas engine or oil engine is installed for the purpose of cutting chaff.

Cotton Spinners and Weavers.—It is in the busy districts of East Lancashire that cotton spinners and weavers are mainly employed. Some factories are given up entirely to spinning and others solely to weaving. In comparatively few cases factories are divided into sections, one for spinning and the other for weaving.

Spinning is the converting of seed cases of the cotton plant into thread, which is wound upon bobbins and warps. Weaving is the making of cotton cloth by intertwining the threads, those running the long way of the piece being the warp; the shorter cross threads being the weft.

In the Lancashire textile districts a system of half-time employment prevails, children between twelve and fourteen years of age attending school in the morning and factory in the afternoon of one week and changing over for the ensuing week. When there are vacancies for half-timers (either girls or boys) a notification of the fact is placed up on the notice boards at the workers' entrance to the factories.

At the same time, it is certain that the half-time system is doomed, and can hardly be much longer continued in view of recent Education Acts.

Upon discharge from the public elementary school a boy or girl may become a full-time worker in a mill. In the spinning many boys go as mule tenters, tying broken threads as the great mule carriages traverse the spinning room. In the weaving sheds there are girl tenters who act as assistants to the weavers; one woman weaver being often in charge of four looms with a tenter for each.

In the far east of Lancashire many cotton spinners have become master men and have acquired considerable wealth under a system of renting space in a large co-operative mill.

Cutters, Tailors'.—It requires a considerable amount of innate artistic taste to become an expert tailors' cutter, and men of outstanding ability may command very large salaries. The majority of cutters commence as apprentices in the tailoring trade. In very few cases is a premium charged; and then only with the largest firms. There are technical classes in tailoring and cutting at many of the continuation classes as well as expert test-books bearing upon the subject.

Detectives.—To become a police detective or an officer attached to the Criminal Investigation Department it is essential that the aspirant shall join a police force as an ordinary constable and work his way up through the service.

So far as private detectives are concerned, they are almost universally ex-inspectors of police and ex-detective inspectors.

District Nurses.—There are very few parishes without a district nurse, whose duty it is to attend to the nursing of the afflicted poor in their own homes. Those who desire to enter this calling should communicate with the *Secretary of Queen Victoria's Jubilee Institute for Nurses, 58, Victoria Street, London, S.W.*1.

The Institute has branches in all parts of the kingdom where district nurses may receive their training; and the conditions of the course are that the applicant shall serve for one month on trial. At the close of that probationership she is asked to sign an agreement to serve as a district nurse for one year in any district to which she may be sent and, upon that understanding, is given six months' training.

Drapers.—In this trade it is customary for youths and girls to begin as apprentices. The period served is usually about four years and most apprentices live in and receive a small allowance as pocket money. Following upon the apprenticeship the worker passes to a larger or different shop as an improver, and in time will become a fully fledged assistant, with the possibility of eventually becoming a shopwalker or buyer; and, in some circumstances, a commercial traveller. In almost every case the greatest possible effort is made to obtain breadth of experience, for the trade is one with many aspects.

To open a drapery business it is essential that the aspirant shall have passed through the trade. The position of buyer or traveller gives one an excellent experience for the opening of a new establishment. The capital required is invariably large.

Dressmakers.—This class may be divided into those who work in their own homes, those who visit the homes of their patrons to work; those who have shops; and those who are employed by shopkeepers or even in wholesale houses. In every case it is necessary that the worker shall serve an apprenticeship of about two years and during this period food may sometimes be given, though wages will be small. As a matter of fact, in high-class houses the apprentice is called upon to pay a considerable premium.

Drill Instructors.—In the service of our public elementary and secondary schools there is invariably a demand for drill and physical exercise instructors. Many of the vacancies are filled by ex-Army men, but there is a considerable opening for the layman, and those who aspire to this work should take a course in drill, Swedish drill, physical culture, boxing, and similar pursuits. In this calling there is also a demand for trained women to teach girls.

Dyers.—In the heavy woollen districts of Yorkshire and in other centres where cloth is manufactured the dyer is a highly-skilled worker upon whom much depends. Master dyers are paid very high wages and need to have had lengthy experience in the blending of colours. Usually a young man learns this trade by becoming a dyer's labourer. A. C. M.

BOOK-KEEPING.—XXXIV

In the last lesson we saw that the Income Tax was a variable amount; e.g. where the income is unearned and does not exceed £1,000 but does exceed £500 the tax is 3s. 6d.

In the case of earned income lower rates apply on incomes under £2,500: e.g. earned income exceeding £130 but not exceeding £500 pays 2s. 3d. in the £.

The distinction between earned and unearned income is merely that unearned income is such income as is obtained from rents, interest, dividends and the like, whereas income received for services rendered is considered to be earned income.

Super Tax is also charged on a sliding scale. On incomes exceeding £2,500, in so far as these incomes exceed £2,000, the taxable amounts are: e.g.

£2,001 to £2,500 inclusive, 1s. per £.
£2,501 to £3,000, 1s. 6d. per £.
£3,001 to £4,000, 2s. 0d. per £.
£4,001 to £5,000, 2s. 6d. per £.
£5,001 to £6,000, 3s. 0d. per £.
£6,001 to £8,000, 3s. 6d. per £.
£8,001 to £10,000, 4s. 0d. per £.
£10,000 and upwards, 4s. 6d. per £.

A common accounting problem is the drawing up of a statement showing the income liable to Super Tax. The following examples will illustrate the mode of procedure.

EXAMPLE I.

The Profit and Loss Accounts of the business of J. Wilson, as agreed with the Inspector of Taxes, showed the following results:—

1916 Profit	£7,220
1917 Loss	850
1918 Profit	6,020

J. Wilson's gross income in addition to the above for the year preced ng assessment was

Dividends	£1,000
Directors' Fees	750
Rents (Schedule A net assessment)	500
Wife's Income	400

RETURN FOR SUPER TAX FOR THE YEAR 1919–1920.

	£	s.	d.	£	s.	d.
Profit 1916				£7,220	–	–
Loss 1917	£850	–	–			
Profit 1918				6,020	–	–
	850	–	–	13,240	–	–
Less Loss				850	–	–
Gross Profit—3 years				12,390	–	–
Average Profits				4,130	–	–
STATUTORY INCOME FOR YEAR 1919–20						
Average Profits				4,130	–	–
Dividends				1,000	–	–
Directors' Fees				750	–	–
Rents (Schedule A net assessment)				500	–	–
Wife's Income				400	–	–
				6,780	–	–
Less Ground Rent				70	–	–
Total for Super Tax purposes				£6,710	–	–

NOTE.—Life Assurance Premiums are not allowed as a deduction.

He paid £70 ground rent and £150 Life Assurance Premiums.

His assessment for Super Tax would be as shown in the table on p. 501; the amount payable would be as follows:—

	£	s.	d.
£2,000 free	nil		
500 at 1s. 0d. in £ ..	25	0	0
500 at 1s. 6d. in £ ..	37	10	0
1,000 at 2s. 0d. in £ ..	100	0	0
1,000 at 2s. 6d. in £ ..	125	0	0
1,000 at 3s. 0d. in £ ..	150	0	0
710 at 3s. 6d. in £ ..	124	5	0
£6,710	£561	15	0

2. Under what Act is "Super Tax" imposed, and by whom is the tax assessed?

The annual Profit and Loss Accounts of the business of George MacArthur showed the following profits: 1916, £7,200; 1917, £6,500; 1918, £5,800. These profits were arrived at prior to making any provision for depreciation, for which an allowance of £250 was made by the Surveyor in each of the above-named years.

He was insured with the Universal Life Assurance Company at an annual premium of £450. His private income consisted of: Dividends from Investments, £1,200; Rents from House Property, £600; and Interest on Loan on Mortgage, £350. His income is stated gross in each case.

Prepare George MacArthur's Return for Super Tax.

RETURN FOR SUPER TAX FOR THE YEAR 1919–1920.

Share of Profits of J. Brown and Co. for 1918–1919 ..				£6,175	–	–
Interest on Capital in J. Brown and Co.	£500	–	–			
Salary as Partner in J. Brown and Co.	500	–	–			
Dividends (£280 plus tax deducted £120)	400	–	–			
Wife's Income (£140 plus £60 for tax at 6s. in £) ..	200	–	–			
Salary as Member of Parliament (£400—£100)	300	–	–			
Rent (Schedule A assessment)	380	–	–			
Leasehold residence assessment	500	–	–	2,780	–	–
				8,955	–	–
Less Ground Rent				50	–	–
Income for Super Tax purposes				£8,905	–	–

Super Tax would be paid on £6,905 (£8,905—£2,000).

NOTE.—A Member of Parliament's salary is not taken at the full £400 for Income Tax purposes. He is allowed to deduct £100 for expenses.

EXAMPLE II.

From the figures given below, prepare J. Brown's return for Super Tax for the year 1919–1920.

Share of profits in J. Brown and Co. for year 1918–1919..	£6,175
Interest on Capital	500
Salary as Partner	500
Dividends from Investments £280 net (tax 6s. in £) ..	280
Wife's Income free of tax ..	140
Salary as Member of Parliament	400
Rents	350

Net Schedule A assessment £380.

His residence, which is his own property, is assessed at £500 net.

This residence is subject to a ground rent of £50.

Work the following Exercises:—

1. What are the chief differences between a Balance Sheet prepared under the "Double Account System" and a "Single Account" Balance Sheet? State briefly the defects of the "Double Account" method of presenting a Balance Sheet (see pages 305 to 308).

KEY.—£5,300 liable to Super Tax. Note.—Rents £600 less one-sixth for Sch. A assessment, although this is not necessarily so.

3. George Dixon, a shareholder in Rayon D'Or, Limited, had applied for, and was allotted, 200 Ordinary Shares of £1 each. He duly paid 5s. per share on application and 5s. per share on allotment, in accordance with the conditions of the issue. A call of 5s. per share was made by the Directors, and was payable on August 1, 1919, but all applications for the amount due from him were ignored by George Dixon. Under the provisions of the Articles of Association, the shares were forfeited by Resolution of the Directors on December 31, 1919.

Give the entries recording the above transaction which would appear in the books and accounts of the Company (see Vol. IV., pp. 310–12; 370–74; 438–40).

4. Under what schedules would the following classes of income be assessable:—

(i) Salary of a clerk of a limited company.
(ii) Profits of a farm.
(iii) Interest on Consols.
(iv) Salary of a clerk of a private firm.
(v) Profits of a solicitor (which included £200 as salary as Magistrate's Clerk).

For solution of the above question, see page 430.

Note that in Case (v) the solicitor is assessed as having a private practice, and also as being the servant of a public body.

F. H.

SHORTHAND.—XX

Key to Exercise 72

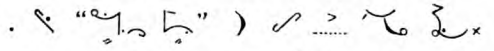
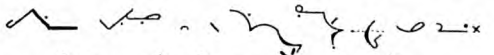
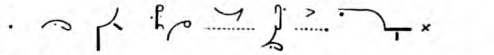
James Wilson *and*-Sons,
84 Goschen Street,
Lincoln.

Gentlemen,

We-thank-you for-your-letter *of-the* 18th inst., *and for-the* accompanying order. *Your* complaint about-*the* suitability *of-the* packing *shall-be* investigated. *We* regret *that our* announcement referring *to-the special* paintings *and* engravings *we-had on* sale *during* December *did-not* reach you *in*-time *for-you to* entertain purchasing certain lines *you*-were requiring. *The* majority *of-the* best pictures went *very* early indeed, *but-we-have* still *on hand* "Sleeplessness," "Dolefulness," *and* "Morning," *any of-which-we-shall-be* pleased *to*-forward *at-the* catalogue prices. *Yours-truly*

Norman *and* Danby.

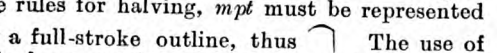
Key to Exercise 73

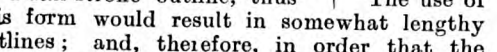
1. . 
2. 
3.
4. . 

Contractions.—In order to assist the student to attain the highest speed possible compatible with legibility, many words of frequent occurrence, additional to those represented by logograms, may be contracted in accordance with the rules set out in this lesson. Such contractions are divided into two groups, General and Special. General contractions, with which we shall here deal, consist of groups of words in which a medial consonant is omitted, or in which a final syllable is omitted or abbreviated, in order that an awkward joining or a lengthy outline may be avoided. Special contractions consist of particular words which require a special or an exceptional treatment. *Pitman's Exercises on the Grammalogues and Contractions* (6d.) contains a full list of grammalogues and special contractions, and will be found of great assistance to the student.

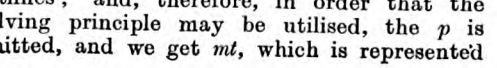
General Contractions.

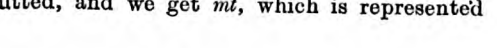
(1) *P* is omitted (*a*) between *m* and *t*, or (*b*) when it occurs between *m* and *sh*, if no vowel follows after *p*. Take, for example, the word *prompt*, in which *p* is a lightly-sounded consonant between the *m* and *t*. According to the rules for halving, *mpt* must be represented by a full-stroke outline, thus The use of this form would result in somewhat lengthy outlines; and, therefore, in order that the halving principle may be utilised, the *p* is omitted, and we get *mt*, which is represented by half-length *m*. Thus we have *mpt* represented by *mt*, and this involves no loss of legibility. Note the following examples—


pum(p)ed, presum(p)tive, bum(p)ed,


rom(p)ed, swam(p)ed, hum(p)ed.

Note also the following examples of the omission of *p* between *m* and *sh*—


redem(p)tion, resum(p)tion,


exem(p)tion, presum(p)tion,

gum(p)tion, assum(p)tion.

The *p* is retained in such words as
trumpet,

lumpish, dampish, because a vowel immediately follows the *p*.

Proper names containing *mpt* and *mpshun* require, for the sake of clearness, the use of the compound consonant, thus,

Simson, but *Simpson,*

Thomson, but *Thompson,*

assumption, but *Assumption.*

(2) *K* or *G* is omitted (*a*) between *ng* and *t*, or (*b*) between *ng* and *sh*, if no vowel occurs after *k* or *g*.

Note the following examples—

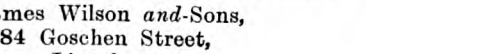
pun(c)tual, extin(c)t, distin(c)t,

adjun(c)t, an(x)ious, an(g)uish,

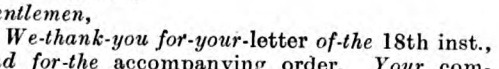
compun(c)tion, distin(c)tion.

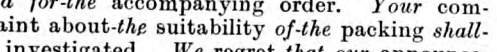
In
junket, trinket, and similar words, the *k* or *g* is retained, as a vowel follows the consonant.

(3) *T* is, as a general rule, omitted between circle *s* and a following stroke. This form of contraction is very useful, and the words included under this rule are of more frequent occurrence than those of rules (1) and (2). Take, for instance, the full outline for the word *postpone* , and compare it with the outline , in which the *t* is omitted. It is obvious that in the latter form there is increased facility, with no loss of legibility. Note the following examples—


lis(t)less, pessimis(t)ic, las(t)ly,

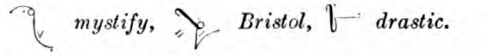
optimis(t)ic, pos(t)age, pos(t)card,


subs(t)itute, tas(t)eful, tes(t)ament,

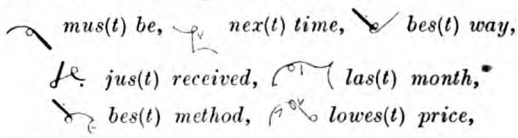

res(t)less, was(t)eful, manifes(t)ly.

Where the omission of the *t* might cause hesitation in transcription, or where it is equally easy to include it, the consonant

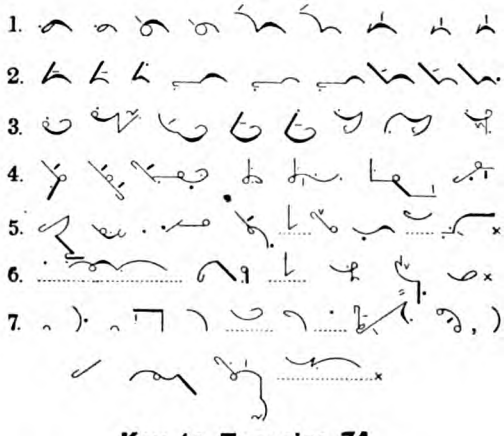
should be written, as, for instance, in the following words—


mystify, Bristol, drastic.

The principle of omitting the *t* may be usefully extended to phrasing, as will be seen from the following examples—


mus(t) be, nex(t) time, bes(t) way, jus(t) received, las(t) month, bes(t) method, lowes(t) price, your las(t) letter, mos(t) important.

Exercise 74



Key to Exercise 74

1. stamp, stamped, swamp, swamped, romp, romped, hump, humped, hummed.
2. jump, jumped, jammed, cramp, cramped, crammed, bump, bumped, beamed.
3. sanction, sanctuary, function, junction, conjunction, anguish, languish, anxiety.
4. postage, postpone, procrastination, testament, testimony, text-book, waistcoat.
5. *We-shall-be*-glad *to*-send-*you the* articles post-free *at-the* price named *in-our* catalogue.
6. *A most-important*-matter *will-be* considered *at-the* Institute *on*-Friday *next.*
7. *You* say *you* got *your information from a* trustworthy source, *so we must-not-be* presumptuous *in-the*-matter.

Other general contractions are formed by the omission of—

(*a*) Medial *n*, as in *messe(n)ger, ide(n)tical, disappoi(n)tment.*

(*b*) Medial *r*, as in *demonst(r)ate, remonst(r)ate, manusc(r)ipt.*

(*c*) The syllable *-ect*, as in *exp(ect), proj(ect), resp(ect).*

(*d*) *K* and *T* in the syllables *-active, -ective, -uctive*, and similar endings, the hook *v* being added to preceding stroke; thus,

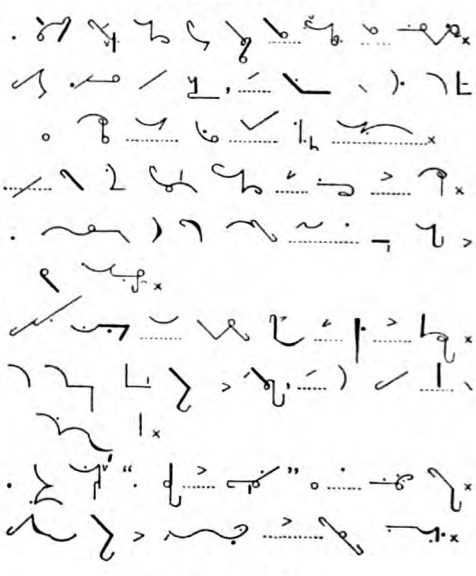
respec(t)ive, abstrac(t)ive.

In a few cases it is desirable that the *k* be retained, as in *defec(t)ive*, or that the full outline be written, as in *adjective, invective.*

(*e*) *K* in the syllables *-ection, -uction*, and similar endings, the *shun* hook being added to the preceding stroke; as in *destr(uc)tion, obj(ec)tion.* The full outline is, in some cases, preferable, as in such words as *attraction, affection, infliction,*

The student should now work carefully through the following exercises, the key to which will be given in the next lesson.

Exercise 75



Exercise 76

1. *The* little fellow recited *a* selection *from* "*The* Lay *of-the* Last *Minstrel.*"
2. *We-have every prospect of-the production* proving successful.
3. *Henceforward we-shall* take steps *to*-prevent such *an appointment.*
4. *I*-am *very* fond *of perspective* drawing, *and* hope some day *to become an architect.*
5. *The messenger you sent* here *this* morning *is very respectful in-his* manner *and* speech.
6. *Our* manager says-*the manuscript is very imperfect, and he* looks *to-you to*-revise *it.*

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